H. 21 3/2

H 23/2

Pocha's Garden Guide

91

39

POCHA'S GARDEN GUIDE

A COMPENDIUM OF USEFUL INFORMATION ON GROWING VEGETABLES, FLOWERS, ETC., IN INDIA, WITH CHAPTERS ON MANURES AND INSECT PESTS and DISEASES.

PESTONJEE P. POCHA & SONS
SEED MERCHANTS : : POONA, 1.

Price, Rs. 3/50.

7TH EDITION ... 1952 (Revised.)

Published by Pestonjee P. Pocha & Sons, and printed at Pocha's Horticultural Press, No. 1A, Middle Road, POONA 1.

CONTENTS

PART I — PAGES

SUGGESTIONS ON SEED SOWING 7-17

PART II

MANURES AND FERTILIZERS 19-36

PART III

FLOWERS, THEIR CULTURE, DISEASES & PESTS 38-97

PART IV

VEGETABLES, THEIR CULTURE, DISEASES & PESTS (Arranged according to families) 100-156

PART V

LAWNS, LUCERNE, PAPAYA, HEDGES AND GUINEA GRASS 159-168

PART VI

TEN USEFUL FORMULÆ .. 170-172

PART VII

USEFUL INFORMATION 174-180

INDEX 181-184

This is a reference book which must always be kept ready at hand. It contains a wealth of practical and useful information seldom found in other similar works.

Do not omit to go through the Index, given at the end of the book, if only to know what subjects are treated.

PART I

Suggestions on Seed Sowing

WHAT IS A SEED ?

A seed holds the germ of plant life. Large or microscopic, it will develop according to variety, into a sky-reaching giant tree or a tiny creeper that hugs the ground.

Quality in seed is not in the seed itself or its appearance, but in the inbred quality of that seed to yield a superior product. Good seed and inferior seed may look exactly alike, but there is an invisible difference, distinctly in evidence at harvest time. Since time and labour are the heaviest expenses of gardening and the cost of the seeds the least, we strongly advocate that you choose your seeds carefully and with discrimination from Seedsmen who have a reputation of observing quality and who are actively engaged in maintaining and advocating that precious factor so important and imperative with seeds.

CONTENTS OF PART I

SUGGESTIONS ON SEED SOWING

	Page
Essentials of Success	7
Composition of Soils	7
How to Sow	8
How to Water	8,9
Damping Off	9, 10
How to Transplant	12
Slow-Germinating Seeds	14
Ants	15-17

SUGGESTIONS ON SEED SOWING

Essentials of success

A THOROUGH KNOWLEDGE of the conditions necessary for the germination of the different kinds of seeds is essential for a successful beginning. The want of knowledge in this matter is too often the cause of much undeserved censure upon the seedsman, for, in nine cases out of ten, the failure is not with the seeds, but results from the time or manner of sowing.

How stored

Seeds should not be kept long before sowing, but should be obtained a few days before required, and if it is necessary to keep some of them for a future planting, they should be carefully stored in a dry and cool place. If left to themselves they are likely to deteriorate, as moisture and heat have an adverse effect upon them. They should be kept in a tin box with a close-fitting round lid, or better still, in a glass stoppered bottle. This should be put away in a closet or a cupboard where no direct draught reaches them.

Composition of soils

Many cases of failure in germinating are due to unsuitable soil conditions. It is physically impossible for young seedlings to send their tender shoots upward through soil which is hard and packed, nor can the young rootlets pierce downwards in such soil. Let the soil be well dug and pulverised. Fine soil should be sifted on top to at least an inch in depth, and if it be heavy or clayey, should be lightened with sand, well-rotted manure, or leaf-mould. Soil left in river beds after a flood is very good. If mixed with equal portions of leaf-mould, well-rotted cow or horse manure, it is good for almost any seeds to grow in. Where a good, friable, loamy soil is not easily obtainable, earth from woods, if obtainable in the neighbourhood, will also serve the purpose well. In a damp hollow or ravine, where the trees stand closely together and the leaves lie thickest, the best earth will be found. Scrape aside the leaves and gather the loose, decaying mixture of leaf-mould, fine roots and soil, which is usually from one to several inches in depth. Pick out the larger roots and break up any lumps which will not go through an ordinary sieve. From the roadside or the banks of a stream, gather a quantity of fine, clean, gritty sand. These, together with the surface soil of a meadow where grasses grow freely, in equal parts, make a good compost, suited for sowing seeds. The nature or composition of soil is not so important for the germination of large and vigorous seeds such as Peas, Beet, Beans, Corn, etc., but with the delicate and slow-sprouting sort as Celery, Parsnip, Brinjal or Capsicum, and with most flower seeds, it is of much importance.

Pots, boxes and tins

Where seeds are sown on a small scale for private gardens, it is better to use pots, baskets or boxes in preference to sowing them in beds, as they can be removed to the verandah or the sheltered side of a house and protected from heavy rains or direct sun. Pots should be procured before the rains commence, for, during the rains they are difficult to obtain, as the potters do not bake during the wet season. Shallow pots are quite good for sowing seeds; large and deep pots, are not necessary. It is a good thing to place the pots on bricks or broken crocks to help the drainage. One or more holes, about an inch in diameter, should be made in the bottom of the pots.

Empty whisky cases or boxes, which can be obtained cheaply from any wine merchant or grocer, will be found very useful. Saw them

through the middle depthwise, so that the bottom and the top of each will form two shallow boxes, or 'flats' as they are called, with sides about 3 to 4 inches in height. If painted with tar both inside and out, they last quite a while. Kerosene oil tins also cut lengthwise, serve the purpose well, but a few holes should be made in the bottom for drainage.

Drainage

Ample drainage in the shape of broken pieces of flower-pots, rough cinders or small pieces of bricks, should be placed in the bottom of the boxes or pots, and over this a layer of rough soil or dried leaves from the garden should be placed. Cocoa-nut fibre, moss or half-decayed stable litter is also used for the purpose, and should be used wherever possible. These prevent the soil being washed down into the drainage material.

How to sow

The pots or boxes should be filled up to about half an inch from the surface, putting the sifted soil on the top, from which all stones, etc., have been removed. Smooth down the top with a wooden board about eight inches square, to which a small handle has been attached at the centre. Then, with a pointed stick, mark out rows about half an inch deep, at distances of, say, two or three inches, in the boxes or pots and of about six inches in the beds. Drop the seeds in, a little pinch at a time in the rows, taking care to see that too many of them do not fall in one spot. Very small seeds may be sown broadcast. Sow large seeds one by one, an inch apart, sift earth over all to cover them as deep as about three or four times their diameter, and then press down firmly again with the board or the palm of the hand. Hard-shelled seeds like Cannas, Ipomœas, etc., should be soaked in warm water for about 24 to 48 hours before sowing or they may also be kept in cow dung paste for 2 to 3 days and then immediately sown. This hastens germination considerably. Then lay over the soil a piece of thin cotton cloth (this is not absolutely necessary) and water with a fine spray, or a watering can with a fine rose, thus sprinkling the water very gently and in small drops. The cloth should be removed as soon as the seeds show signs of coming up. In bright or dry weather, the use of a pane of glass over the pot retards quick evaporation and helps uniform germination. The glass should be removed as soon as seedlings show above ground.

Depth of sowing

Large seeds like Nasturtiums, Sweet Peas, Beans, etc., should be covered about one to two inches deep, and smaller seeds according to size; the usual rule being to cover them about 3 to 4 times their diameter. Very small seeds, like Begonias, Gloxinias, Mimulus, etc., should be first mixed with a handful of fine, sifted soil, and evenly distributed over the surface and pressed down gently but firmly as before. Great care should be exercised in opening a small packet of any of these fine seeds, as an awkward jerk, or a light puff, will scatter a whole packet of expensive seeds.

How to water

Rough or injudicious watering is also a frequent cause of failure, especially in the case of small seeds, like Begonias, Gloxinias, etc., and it is an excellent plan to water the soil before sowing the seeds, and then, after sowing, to stand the pot in another pot or pan half filled with water. Thus the soil soaks the water from the bottom, and overhead watering is avoided. Care must be taken to replenish the water in the lower pot from time to time. It is

also necessary to lift the pot daily from the lower one containing water and allow it to stand by itself for a few hours and change the water frequently. This enables extra moisture to drain off, as stagnant water is detrimental to germinating seeds and seedlings.

Tiny seeds—A novel method

Many people fail to grow some of the tiny expensive seeds by the ordinary method. The following method, though novel, is found to succeed admirably in raising tiny seeds like Begonias, Gloxinias, Calceolarias and even Fern spores. Secure a galvanized pan, made by a local tin smith, about four inches deep, and large enough to hold an ordinary porous, building brick, without touching the sides of the pan. Take a mixture of light garden soil two parts and fine sand one part. Though not absolutely necessary, it is a good thing to bake the soil to kill weed seeds and fungus spores. The soil is then passed through a sieve and moderately dampened. Apply this soil to the brick to a depth of half an inch or more, sloping it off along the edges to the finish, which prevents its crumbling off. Put enough water in the pan so that the brick is wet upto about an inch, when by capillary attraction the soil will be kept uniformly moist. As soon as in place, lightly sprinkle the seeds on the surface of the soil and place in a shady place where the light is not too bright. If the soil should appear too wet—which rarely happens—just lift the brick out for a few hours and then replace.

When to water

The intervals of watering must be regulated by weather conditions. In dry weather water at least once every day. The best time to water is in the evening. Water as soon as the surface soil begins to show signs of drying. Never let the soil dry out completely. Growing seeds do not require too much water at a time; small quantities at short intervals is best.

Avoid thick sowing

In sowing, it must be remembered that after germination the young plants have to be handled for transplanting; if the seedlings are very close together, this will entail much trouble and probable injury to the plants. If sown too thick, the resulting plants will be weak, and, if damp weather prevails in the very early stages of the plants' life, fungoid disease will spread among them and decimate them.

"Damping off"

It frequently happens that young seedlings die of a sudden and within a few hours, due to the above cause, technically known as "damping off." This is brought about by several causes, the most frequent being injudicious watering. If young seedlings are kept dry longer than is good for them and then, when they begin to wilt, are copiously watered, they succumb easily to the above fungoid disease.

How to avoid it

This will seldom happen if the following precautions are taken: Do not sow too thick; give as much light and air to the plants as possible, without exposing them too much to the mid-day sun. Water carefully, that is, before the plants begin to suffer for want of it. As soon as it is found that seedlings are beginning to die, the best thing to do is to remove those which

are alive—no matter how small—to another part of the garden and re-plant them in fresh soil (which, on no account, should be too wet or cold), and to give them more light and air. A damp and close atmosphere is conducive to the growth of fungus diseases, and is a root cause of the trouble. The disease spreads very quickly; seedlings in close proximity to the affected ones should also be removed, therefore, to a safe distance.

The following extract is reproduced from the article "Microbes--Diseases--Pests" in "The Gardener" for January 1939.*

Damping off

"It has been the unfortunate experience of practically every gardener one season or another, to find one morning a number of bare patches or blanks in his seed beds or seed pans as a result of the death of seedlings in large numbers, though only the previous morning he had been perhaps congratulating himself on his ability to raise good seedlings, and the nurseryman for the good seed he had supplied! If he is asked to explain the cause of the sudden presence of so many blanks or complete loss of seedlings, he will without hesitation blame either the weather or the quality of the seed. This explanation is not given only by the amateur gardener. I had occasion to visit recently a government garden where I found a large number of dead seedlings of phlox in seed pans. When requested to explain this heavy and sudden casualty, the assistant in charge casually replied that the weather was responsible for the high mortality of seedlings. He was thoroughly satisfied with his own explanation, and he was a graduate of an agricultural college! He failed to realise that the much maligned weather conditions did not originate the disease but were only favourable for its incidence in an epidemic form.

"The sudden dying of seedlings, or what is commonly known as "damping off" of seedlings, in seed beds or seed pans is a common disease both of flower and vegetable seedlings. Amongst the ornamentals some of the most susceptible to this disease are amaranthus, antirrhinum, aster, calendula, clarkia, dianthus, gypsophila, lupinus, nicotiana, phlox, petunia, pansy and sweet pea; amongst vegetables are bean, beet root, brinjal, cabbage, capsicum, carrot, cauliflower, cucumber, lettuce, lady's finger, melon, mustard, spinach and tomato.

"The disease does not kill seedlings only after they appear above the soil surface but also before they emerge from the soil. In the seed bed clumps of seedlings topple over as they decay at the collar or soil surface, and the disease spreads from plant to plant especially under moist conditions, hence the weather is blamed for the death of the seedlings. The damping off disease also kills many annuals after they have outgrown the seedling stage, and have reached the flowering stage, e. g., cleome, clarkia, etc.

"Damping off disease is caused by many fungi. They are generally present in most soils, and may persist in them for many years even in the absence of a suitable host. These fungi may also be carried on or in the seed. They are most destructive under moist conditions and therefore seed beds and seed pans must be well drained; but mere good drainage is not sufficient to control this disease, and must therefore be supplemented by soil treatment, and also, if necessary, by seed treatment.

* Formerly published by Pestonjee P. Pocha & Sons, Seed Merchants, Poona.

"In the case of annuals which are susceptible to damping off disease when the plants have outgrown the seedling stage, rotation should be practised, i. e., they and other plants susceptible to this disease should not be planted in the beds in which this disease was present the previous season; but in these beds should be grown only those plants which are resistant to this disease, and the susceptible varieties should be sown in beds not known to be infected, e. g., beds in which cleome had died off this season in large numbers should not be planted again next season with cleome or amaranthus, but may be planted with balsam or zinnia.

Treating the soil

"In order to ensure a healthy crop of seedlings or plants it is necessary to destroy from the soil the organisms that cause this disease, and this can be done by disinfecting or sterilizing the soil. Obviously it would not be economic to sterilize extensive areas but soil in seed beds and flower beds and in small kitchen gardens can be sterilized economically, effectively and without much trouble.

"The chemical commonly used for eradicating the damping off fungi from the soil is what is commercially known as formalin; it is readily available at any chemist's. One method of using this disinfectant is to drench the soil with a solution of one part of formalin in 50 parts of water; the quantity required would be one-half to one gallon per square foot. It is advisable to cover the wet soil for 24 hours with old gunny sacking wetted with this solution. The treated soil should not be sown with seeds or seedlings for at least a fortnight. It should be frequently forked during this fortnight to allow the formalin fumes to escape. Implements used for loosening the soil should also be sterilized, by washing them in formalin solution or by heating them on an ordinary fire to guard against infection being carried on them from infected soils.

"For the soil required for filling seed pans a higher concentration of formalin solution may be used; the soil should be well mixed with the solution; seed pans, unless they are new, must also be washed with this solution. Formalin vapours must be allowed to escape completely from the soil before seeds are sown.

"Another method of disinfecting soil for small containers is to mix thoroughly the soil with a small quantity of highly concentrated solution of formalin. Soil enough to fill a box of the size of an ordinary packing case should be well mixed with about one table-spoonful of formalin diluted with five table-spoonfuls of water. Seed pans or other containers which are not new should be disinfected with formalin solution before they are filled with the treated soil. The soil should be allowed to stand in the containers for at least 24 hours, before the seed is sown. After sowing the seed it is absolutely necessary to water the containers thoroughly to ensure the escape of formalin vapours, or else the seed will be damaged.

"Any of these methods of sterilizing the soil will more or less ensure complete immunity from damping off disease, if the disease is carried in the soil, and not in or on the seed."

The above hints on sowing (pp. 8-9) generally apply to seeds of such plants as require transplanting. Before seeds are sown, therefore, it should be ascertained that they belong to the above group. Among vegetable seeds, there are many, such as Peas, Beans, etc., which require to be sown direct in their permanent quarters. These will be found in Part IV of this Guide under the different headings. Among flowers, there are comparatively few that do not stand transplanting well. Among these, the most prominent are: Bartonia, Calandrinias, Candytufts, Clarkias, Eschscholtzia, Godetia, Hollyhocks, Ipomœas (including Convolvulus and Mina), Larkspurs, Lupines, Mignonettes, Nasturtiums, Nigella, Poppies, Portulacas, Sweet Peas, and Viscaria. These are best put down in the places where they are to flower, and if they come up too thick, should be thinned out by picking off some of the smaller plants, leaving those which look large and healthy.

Which to transplant and which not to

Most of the above, however, can be transplanted successfully if the seedlings are transplanted when quite young, and great care is exercised in handling them. Calandrinias, annual Poppies and Portulacas are typical exceptions.

Almost all the other flowering plants are benefited by being transplanted. They should never be allowed to grow too long in their seedling beds, as they soon begin to crowd themselves out, and thus become weak and prone to immature flowering. Transplanting should be done as soon as they have formed about three or four true leaves (not seed leaves or cotyledons). A few hours before transplanting, the seedlings and also the ground they are to be transplanted to, should be watered, so that the two soil conditions be about equal. The best time to transplant is soon after a shower of rain, or in cloudy weather. If these conditions are not prevailing, select an evening for the operation, as the plants then will have the whole night to establish themselves somewhat, before the sun comes up the next day.

When to transplant

When transplanting, great care should be taken not to injure the roots. The operation should be done with a gentle hand. Take a *khoorpi* or a small transplanting trowel and insert it into the soil, taking out a few seedlings. Separate these carefully, and plant them one by one, in holes just large enough to receive them. Then gently press down the soil near the roots with your fingers. It often happens that the leaves of newly planted seedlings—especially the lower ones—get stuck to the soil after being watered. This causes decay of the plants, leaving gaps in the beds. It is, therefore, well to go over the beds with a thin, pointed stick, and so lift the leaves from the ground. It is also advisable to keep a few seedlings reserved for an emergency, as some of them may die and leave gaps in the flower-beds, which can be thus filled up. In hot or sunny weather, a slight shade over the newly planted seedlings is desirable. Small, leafy twigs of trees inserted a few inches apart, in between the plants, afford a good shade. These may be removed after a few days, when the plants have established themselves.

How to transplant

Should, however, time and labour be available, it is a very good plan to transplant the seedlings as soon as they are large enough to be handled, into other boxes or beds similarly prepared, (but with the soil made a little richer by an additional amount of manure), about an inch or more apart each way, and

Transplanting "in excelsis"

then, when they have made more growth and begin to crowd, to plant them out in their permanent places. When seedlings have been in their second boxes for two or three days, they may be allowed more sun and light and air to harden them. This usually prevents the young seedlings from being "damped off," and makes them more sturdy; altogether, they make better and healthier plants and well repay the extra trouble of transplanting a second time.

Sowing seeds in beds

When seeds, especially vegetable seeds, are to be grown on a fairly large scale, they are usually grown in beds, specially prepared for them, above the level of the surroundings to ensure free drainage, particularly during the rains. See that the soil is not wet, and that a top layer of about two inches or so, is passed through a sieve. If the soil is very wet and cold, the seeds are likely to fail; a dry soil is better than a wet one for sowing. Water the beds thoroughly a few hours before sowing and sow the seeds as directed above in drills (or straight rows), letting them run along the narrow or shorter length of the beds. Cover the seeds more deeply than when they are put down in boxes or pots, say about five times their diameter. Do not flood the beds with water but sprinkle the water carefully whenever required, from a fine-rosed watering can or spray. If the presence of insects is suspected or is known from previous experience, it is a good plan to pour boiling water over the seed-beds a few hours before sowing. This will kill the eggs of snails and slugs which are so destructive to growing seeds.

Permanganate of Potash and its uses

Mr. George H. Copley, N. D. Hort., writes an informative article in "The Gardener" for April 1939 (formerly published by Pestonjee P. Pocha & Sons) on the properties of a solution of permanganate of potash as "a pick-me-up for unhealthy, anæmic plants." Mr. Copley describes in brief the results of experiments with this chemical conducted by Mr. C. B. Greening, B.Sc., at the Royal Horticultural Society, Wisley, England. For the benefit of readers of this "Guide" relevent extracts from this article are given under Tomatoes, Lawns and Compost.

Peas, Beans, easy to grow and yet—

PEAS, BEANS AND MAIZE—These seeds are usually of large size and vigorous germination, and there is very little trouble in growing them, still sometimes they fail to germinate and on removing the soil covering them and examining the seeds, they are found to have rotted. This happens if they are sown in a wet, damp and cold soil, especially during a long spell of wet weather. The round-seeded peas are not so susceptible to rot as the wrinkled peas—and similarly the Field Corn which are usually smooth and large seeded, are not so susceptible as sweet or table Corn. This is due to the large quantity of sugary matter contained in these highly bred seeds, which causes them to decay in a cold and wet soil.

They sometimes fail!

Thus, it often happens that acclimatised peas—even those of the wrinkled type—which have not been grown with an eye to improvement, germinate freely, while imported seeds with a larger percentage of sugary matter, put down side by side, fail to come up, and rot in the ground. These seeds are best put down, therefore, in a freshly prepared, warm soil, which has been frequently turned over, and in a sunny and open situation. This is the most frequent cause of failure of these seeds. The same remarks apply to such oily seeds as Pumpkins,

Marrows, etc., but only in a lesser degree. It must be remembered that seeds and roots require air as much as growing plants, and, if the soil is not loose, but wet and cold, it gets impervious to air, in consequence of which they suffer and die.

Time seeds take to germinate

The majority of seeds usually grow within a week or two. But there are some seeds which take longer and one should know how long to wait before giving them up finally. Among vegetables, Celery seeds usually take from three to six weeks to grow, and often refuse to sprout even after this period, if the weather is not favourable to their growth. So also do the Parsnip, Leek, Onion, and some of the pot-herb seeds, like Lavender, Cat-mint, Rosemary, Thyme, etc. The germination of these seeds is also capricious and uncertain, as they seem to be more fastidious in their climatic requirements than to the soil conditions. A cool and equable temperature seems to be the most favourable to their growth. Among flowers, there are many, like Anemones, Larkspurs, Clematis, etc., which take from four to eight weeks—or even much more—to germinate. Such seeds should be looked after more carefully, and watered regularly, and the surface soil examined from time to time to see that none of the seeds have been exposed, as occasionally happens, after a few weeks, due to the washing away of surface soil. In this case, a fresh layer of soil should immediately be put over them to cover the seeds sufficiently. Another difficulty in growing these seeds is that the surface soil, if not of the right kind, is likely to get packed or baked so hard that seedlings cannot break through the crust that is formed, and therefore die. To overcome this, prepare the soil in the usual manner, and after putting down the seeds, do not rake the seeds in or cover them with any soil; but instead, use some very old and thoroughly decomposed farmyard or stable manure, after passing it through a half-inch sieve, and spread this carefully over the seeds to a depth of about half an inch or a little less, according to the size of the seeds. We give below, for reference, a list of the more important of the seeds which usually take a long time to grow:—

Capriciousness of seeds

Care of "difficult" seeds

SLOW-GERMINATING SEEDS

From 2 to 4 weeks or a little longer

Vegetables—Asparagus, Leek, Parsley, Parsnip, New Zealand Spinach.

Flowers—Alonsoa, Anchusa, Asparagus (Ornamental), Perennial Asters, Bidens, Clitoria, Cyclamen, Datura, Eucalyptus, Geum, Heliotrope, Kudzu Vine, Perennial Linum, Martynia, Matricaria, Mimosa, Myosotis (Forget-me-nots), Nemesia, Ranunculus, Scabiosa caucasica, Smilax, Solidago, Stipa, Xeranthemum.

From 3 to 6 weeks or a little longer

Vegetables—Balm, Cat-nip (Mint), Celery, Celeriac, Lavender, Rosemary, Savory, Thyme.

Flowers—Abronia, Agapanthus, Alyssum saxatile, Amaryllis, Arctotis, Aristolochia, Begonia, Canna, Japanese Chrysanthemum, Cobæa,

Cynoglossum, Euphorbia, Gaura, Gerbera, Hedysarum, Heuchera, Hibiscus, Humulus, Ladies' Lace, Larkspur, Lychnis, Nigella, Passiflora, Polygonum, Verbena venosa.

From 1 to 3 months or longer

Fruits—Raspberry, Strawberry.

Flowers—Abutilon, Acacia, Adonis, Agathea, Ampelopsis, Anemone, Aquilegia, Bignonia, Cactus, Calceolaria, Clematis, Cyperus, Delphinium, Freesia, Fuchsia, Gladiolus, Gynerium argentium, Helenium, Hyacinthus candicans, Hunnemannia, Lantana, Perilla, Perennial or Decussata Phlox, Primula (including Auricula and Polyanthus), Rose, Tecoma, Tritoma, Viola odorata (Sweet Violet).

It may be noted that the above applies only to seeds and their different varieties as offered in our catalogue, and that the time given is only approximate, and many seeds will germinate much earlier than the time indicated, if weather be favourable. Our long and practical experience in growing these and many other seeds has enabled us to make the above list as comprehensive as possible, but still the uncertainty of seeds is so great, and different climates and soils have such varying effects on different seeds, that one is likely to find much variation in the times indicated above. In the majority of cases, under normal conditions, however, they would form a good guide.

It may also be noted that there are some seeds like Phlox Drummondii, Pansies, Verbenas, etc., which, though they usually germinate freely in about 2 weeks, sometimes, owing to weather conditions, fail to show themselves above the ground, for 3 to 4 weeks, or even a little longer. A little patience with them usually pays well. But if seeds put down rather late in the season refuse to come up within a reasonable time, it is advisable to make a second sowing to make sure of a supply. White-seeded Sweet Peas are usually hard-shelled, and take longer to germinate. But, if the covering of the seeds is cut open in one place by a sharp knife, or if they are soaked in warm water for about 24 to 36 hours before sowing, they come up more quickly. Canna seeds, similarly treated, come up quicker and better.

Ants and other enemies

A careful look-out should be kept for ants which are very destructive to seeds, as they carry them off continually. If crude (or ordinary) kerosene oil is sprinkled, they will leave the spot for some time but care should be taken that the oil does not come in direct contact with the seeds. The ants do not usually appear on the surface but work their way through the holes in the bottom of the pots, underground. The presence of small holes on the surface is a sure sign that ants are busy. So also are birds, squirrels, mice, etc., fond of seeds—especially of oily seeds, like Cabbage, Cucumber, Marrow, Lettuce, etc., and must therefore guard against their depredations.

Ants can be a nuisance both in the garden and in the home. You can make a good trap by first dissolving about three quarters of an ounce of ordinary washing soda, and then about an ounce of arsenious oxide (called also white arsenic), in a quart of water. This makes a solution of sodium arsenite. Since it is poisonous, do not use any household utensil

in making it up, but employ a tin can that can be thrown away afterwards. Mix one fluid ounce of your solution with about a pint of honey or molasses, to serve as bait for the ants. Pour the mixture over pieces of wrapping tissue, or excelsior, resting in old preserve-jar lids, and place the traps about the garden and the house. Remembering that a crawling baby delights in putting every conceivable object in its mouth, the poisonous ant traps should be hidden or safeguarded.

If the presence of some insects is suspected, pour some boiling water on the soil and sow on cooling. Again, when seedlings come up, dust soot on them.

The immersion of seeds for a few minutes in 2 percent. copper sulphate solution is also a good preventive. Copper Sulphate (Vern. Morthuthu or Morchu) is easily obtainable everywhere and is soluble in water. Naphthaline powder dusted on the seed-beds is also found to repel ants. Powdered turmeric (Vern. Hulder) has also a similar effect.

If broken pieces of cocoanut (with the kernel) or fresh bones (with some meat on them), are put near the seed beds, the ants are attracted to them in large numbers and can be destroyed by immersing them in hot water. This will have to be repeated several times till the ants disappear.

Another plan, when a nest of red ants is found, is to bund the spot round with clay and pour in boiling water; this is found to be very efficient in the destruction of red ants.

White ants

Take one gallon kerosene oil and half a pound Sunlight Soap. Make small pieces of the soap and dissolve it in hot water to a thick consistency. Boil the kerosene oil on a gas stove (or if gas is not available, on a coal fire) using a vessel at least three times larger than the actual capacity of the oil requires—and when the oil begins to boil, which it will do within a short time, slowly add the prepared soap and constantly stir the oil till it is fully mixed with the soap. This process is dangerous and great care should be taken to see that no spark of fire gets into the oil, otherwise the oil will at once ignite. Keep a large quantity of sand handy in case of an accident. While preparing the above emulsion, care should be taken that the oil fumes do not enter into one's lungs or eyes. A pair of goggles and a light bandage over the nose may be used though not absolutely necessary. The above can be applied to wood or any furniture or can be sprinkled where white ants abound and is found very effective. If a nest of white ants is found, it should be dug up and the queen ant found and destroyed. (See also pp. 83-85 for other useful hints.)

Red ants

An ant colony consists of many individuals divided into different castes. The majority of the members of a colony, however, are worker ants. They gather the food, store it and feed the young larvæ in the nests. Another very important member in the colony is the queen, or mother. Not like the bees, among whom only one queen is allowed in the colony, an ant colony may have two or more queens. The queens are the only members that lay eggs. During certain seasons of the year winged ants may be seen leaving the nests. These are males and females of the colony, each couple starting out to begin housekeeping for itself. Fortunately for our peace of mind, many couples perish.

The little red ants that make the small rings of soil on the lawn and the cement sidewalk are perhaps the hardest to control. Injecting boiling water, kerosene, old crank-case oil, or gasoline into each burrow is often effective. Calcium cyanide has been recommended. On lawns, carbon bisulphide will do least injury. Powdered sodium fluoride scattered where the ant rings are thickest will eventually eliminate the pests. In the use of all or any of these materials against this form, it is a case of finding out if you are more persistent than the ant. It is simply a case of continually keeping after them.

The ants that build good sized mounds or nests are easily eliminated by carbon bisulphide. Make several deep holes in the mound, about 6 inches apart. Into each hole pour a quarter of a cup of carbon bisulphide. Cover the nest with a wet sack or rug to keep in the fumes and keep covered for ten or twelve hours. **Do not forget that carbon bisulphide is inflammable.**

For ants that work in hollow trees, carbon bisulphide may be injected.

Certain ants may often be found making galleries around the roots of plants like asters, calendulas, and others. These ants are paying attention to and waiting upon the plant lice which are working on the roots of these plants. Nicotine sulphate diluted at the rate of one to 800 poured around the roots of the plant will kill the plant lice and hence remove the ants.

Any of the ants mentioned may find their way into houses. When they have found a good source of food supply it is impossible to keep them away unless drastic measures are taken. If one is patient enough he can trace ants back to the nest and destroy the nest with the methods mentioned. An easy way by which to trace the ants is to give them a little granulated sugar and then watch them carry it away. If the nest, however, is beneath the floor or in the walls of the basement this method is impractical. One good method is to sprinkle sodium fluoride over their favourite runways. Another is to place in small boxes with tightly fitting covers a poison substance that these workers will carry back to the nests to feed the young and the queen. The boxes should be so arranged that with the cover partly pressed on, the ants can find their way into them through small openings and have easy access to the poisoned material. This poison may be put on bits of sponge and left around but if placed inside the box the poison is not so likely to be disturbed by children and small domesticated animals.

The latest remedy to eradicate insect trouble from the soil, including **white ants** is to spray the area with D.D.T. after digging the soil to a depth of 3 to 4 inches. See chapter VI for preparing poison baits, and other insecticides and fungicides.

PART II

MANURES AND FERTILIZERS

CONTENTS OF PART II

	Page
Manures	19
Fertilizers	22
Green Manuring	26
Liquid Manure...	27
Soil and Manure	28
Fertilizers or Chemical Manure	29
Manurial Programme for the Garden ...	30
Activated Compost	33

*(The following article by "Sherrard," is reproduced from "The Gardener" * for January 1938, by kind permission of the author.)*

MANURES

What is Humus?

This term, humus, is usually applied to decayed vegetation which lies thickly under old forest trees. It is the accumulation of fallen leaves, branches and undergrowth, which has lain on the earth for several years, where it has become thoroughly decayed and pulverised.

What is Loam?

The term loam is usually applied to surface soil richly mixed with humus. Plants grown on such soils will produce crops peculiar to the vigour of nature. But such land is not always available. Moreover, crops will draw out all the richness from the soil in a very short space of time. It is for these reasons we must regularly replenish the stock by applying manure to the soil.

Not only decayed vegetation, but also any decomposed organic matter, such as animal and bird droppings, etc., impart manure and render the soil loamy.

Cow manure is, as a rule, easily procurable and is a good manure for all purposes. Bazar sweepings and kitchen sweepings are also good manures. All these should be collected and conserved for use.

How to conserve Cow Manure

Dig a circular pit not more than a foot deep, and as large as your requirements demand, in some out-of-the-way corner. Dump the manure into this in a cone-shape so that all water can easily drain off. The dump should extend right up to the circumference of the pit, so that no water can drain into it. With the earth taken out to make the pit, cover up the manure at least an inch thick. At the end of a year the manure will be thoroughly decomposed. Do not dump the manure into a pit and flood it with water, as is usually done. This certainly hastens decomposition, but hastens deterioration of the necessary elements as well and washes most of them away.

Make your own Humus

One of the richest forms of humus from your own garden is daily thrown over the wall or hedge into your neighbour's compound, there to waste and be lost. If you have a garden, you have tons of rubbish which is valuable plant food; conserve it and make it into a rich concentrated organic compost.

Rubbish and weeds will accumulate quickly; properly treated, they can be made into a rich substitute for farm-yard manure. A pit should be dug, and into this is thrown all garden refuse, such as weeds, leaves, prunings; all kitchen refuse, such as wood ash (not mineral coal ash), vegetable peelings, and wash-up water. All material of woody nature should be first burned, and the ash, which is rich in potash, is then thrown into the pit. Each basketful of rubbish should be well spread out so that all the different kinds of refuse will be thoroughly mixed. Each layer, six inches deep, should be rammed down and a thin layer of earth, about an inch deep, spread over each layer of refuse. If the urine from the cattle-shed is conserved in

---

* Formerly published by Pestonjee P. Pocha & Sons, Seed Merchants, Poona.

masonry tanks, instead of being allowed to waste, and this is sprinkled over the rubbish daily, a most valuable concentrated mixture will result. But, and a big BUT, do not permit anything to be thrown into the pit that will not decay – no brickbats, etc., because these will be a source of endless trouble.

As soon as the pit is full, the material should be dug out and stacked, as described for cow manure, leaving the pit empty for the next lot of refuse. The top layer in the pit will go to form the bottom of the stack. In this way the decomposed material will be at the top of the stack ready for use.

In wet weather the better plan would be to stack the rubbish in a heap, rather than in a pit, covering each layer with a layer of earth and heaping earth around the sides to prevent exposure to rain and sun.

Green Manuring

Green manuring is yet another means of enriching the land. This consists of growing a certain crop which, when about half grown, is cut down and ploughed into the soil. For this purpose, a leguminous crop is, as a rule, used, because it serves a double purpose. The leguminous family of plants are those which bear pods, such as peas, beans, etc. They have the power of drawing nitrogen from the air by means of small nodules on the roots, with which they are furnished. No other family of plants can perform this function. They can also draw nitrogen from the soil by absorption through the roots in the usual way. The nitrogen taken in from the air is held captive in small nodules. When such a crop is ploughed into the land before the nitrogen is drawn up by the plants themselves, all the nitrogen thus collected is retained within the soil.

In addition to this, improved results are obtained by the mere addition of vegetable matter to the soil, and by the disintegration of the soil by the roots.

I would classify this form of soil improvement next in importance to manuring with farm-yard manure. Land which is regularly green manured without the addition of any fertilizer will show no signs of exhaustion over very long periods. Where farm-yard manure is not available, green manuring, in conjunction with commercial fertilizers, should form the basis of soil improvement.

Sunn hemp, vernacular Sanai or Tag (Crotalaria juncea) is perhaps the best plant to use for this purpose. Cut down just before it comes into bloom, and, ploughed or dug in, it will not only impart, when rotted, high manurial properties to the soil, but will, in addition, furnish humus, bind a sandy soil, and lighten a clayey one. Three or four ploughings may be necessary to work the withered plants into the soil. A dressing of lime immediately after ploughing in the green crop will give excellent result.

As soon as any crop on the land has been collected, the plants should be cut down and dug into the soil, instead of, as is usually done, collecting the stumps and burning them. [*See also page 26.*]

Lime

Average soils in India do not require any addition of lime. Lime, though it does enter the plant tissue (and then only in very minute quantities), has, as its chief function, to change the insoluble and otherwise unavailable potash and phosphoric acid in the soil into available forms. It acts as the agent whereby plant-food is converted into a suitable medium for absorption by the roots. It, as it were, gives life to certain bacteria in the soil, which, in turn, enable the plant to absorb the elements in the soil.

(The relative acidity of the soil is disturbed by careless or injudicious fertilizing. Plants are very susceptible to unstable "pH" value or hydrogen ion concentration in soil. Calcium nitrate and ammonium sulphate applied in correct proportions will generally keep this "pH" value or relative acidity stable. If the soil is too alkaline or 'sour' the plants will not show favourable progress. Similarly 'sweet' or too acid soil will have identical reaction on plant life.

Soil chemists have their own methods of determining the pH value which ranges from 1 to 14. They consider 5.6 to 6.0 as best for plants. Of course it is very difficult to find out this value in garden soils by any rule of thumb. Persons following the hobby of growing plants by the water culture (Hydroponiacs) or soil-less method can find out this value easily for their nutrient solutions, by applying the litmus test. The solutions which keep blue litmus paper blue are definitely less acid with more than pH, 6.6 or 7.0. If the litmus paper turns pink on dipping it in the solution the pH is about 6.0 and this is considered best for plants grown in soils. Deeper shades of pink and red on the litmus paper indicate more acid solutions and pH value is 5.0 or less than that. Ed.)

Lime has the power of packing a sandy soil, pulverizing a clayey soil, liberating the latent elements in the soil, and removing acidity from a damp, sour soil. It accelerates nitrification, assists in decomposing vegetable matter, and destroys fungi. It is a true soil amendment. This amendment of the soil tends to lengthen the growing season for crops, increases capillary moisture, reduces the cost of cultivation, and increases productiveness, thereby increasing the value of the land. No soil can be really fertile without lime, no matter how heavily manured.

In dry districts lime is more abundant in the soil than in districts which have a heavy rainfall, because rain-water tends to wash the lime out of the soil. It is for this reason that damp soils are frequently found to be sour. This condition is due more to a lack of lime than to the presence of acids.

Normally, all natural waters contain lime which has been taken in solution form from lime-contained strata. Land irrigated from such a source is constantly supplied with lime. Rain tends to wash this out of the soil. Where rainfall is heavy, it will carry the lime down to the lower depths out of reach of shallow-rooted crops.

When a soil is adequately supplied with lime, the demand will be greater than would otherwise be the case. The reason is not far to seek. It is the lime that sets free the necessary elements in the manure, and these are greedily devoured by the plants, resulting in increased production, but at the same time rapid soil exhaustion. Consequently, to derive the greatest value from manures, lime must be adequate; and, at the same time, the appreciation of lime in the soil is possible only when the soil is well manured.

There are many forms of lime. Quicklime (Calcium oxide) and ground limestone (Carbonate of lime) are the best forms to use. The former is soluble in water, and is therefore preferable if quick action is desired. Both are equally effective for the purposes described.

Quicklime is derived by burning lime-stone at a red heat. When this is exposed to the air, another change takes place, and the lime is then known as air-slaked lime. Quicklime is changed to hydrated lime by adding to it about

half its own weight of water. This causes the lumps to crumble to powder form. In all these forms the lime is caustic, and all forms are equally effective.

The purer and finer the lime, the more rapid its action. Large granular limestone will remain for a number of years in the soil without producing much effect. For this reason the caustic forms are more often used.

An extended period of growth as a result of which the wood does not mature and fruit does not ripen properly is most probably due to deficiency of lime in the soil.

How and when to use Lime

Lime may be applied to the soil at any time. For growing plants it is safer to use lime in carbonate form as it is more or less inert, and the caustic forms on fallow land, as it is likely to injure the tender crops. The land should first be ploughed or dug to a depth of six inches and the surface smoothed over. The lime is then evenly spread over the surface and stirred into the soil by harrowing or ploughing. After lime, in any form, has been exposed to the air and moisture in the soil for about a month, the poisonous substances disappear and the land may then be safely cultivated.

Smaller and frequent applications are more economical than large applications at longer periods. Normally about 60 maunds an acre or a pound to a square yard, will be required annually, but for very acid soils, or if used to improve the texture of a clayey soil, much larger amounts will be required. Even so, it is far better to make light, but frequent, applications.

Never apply lime immediately before or after manuring the soil. As a general rule lime should be applied immediately after the crop has been removed.

(The following article by "Sherrard," is reproduced from "The Gardener" for April 1938, by kind permission of the author.)*

FERTILIZERS

Organic manures not only provide plant-food, but they also mechanically improve the condition of the soil. They tend to make a heavy soil lighter, and cement a light soil into a cohesive mass. They continue to decompose still further and become black humus. Humus is the essence of soil fertility. Chemical fertilizers are stimulants which nourish the plants only. With the exception of one or two, they do not improve the texture of the soil. If chemical fertilizers were to be used as a substitute for farm-yard manure, instead of as a supplement, over a period of a number of years, the soil would soon be rendered unfit for further cultivation.

An organic manure is essential. A chemical fertilizer is a necessary evil, to be applied only when organic manure is not procurable in sufficient quantity or is lacking in some specific element. I have said "necessary evil" but this expression may be regarded by some as rather scathing. It

* Formerly published by Pestonjee P. Pocha & Sons, Seed Merchants, Poona.

is no new one when applied to many dietetics necessary for our present-day artificial existence. This is also true to a certain extent of plant-life under cultivation. Of the elements necessary to plant life, (1) carbon and (2) oxygen are absorbed from the air by the leaves and roots; (3) hydrogen is absorbed from water by the roots; (4) nitrogen; (5) potash; (6) phosphorus; (7) calcium; (8) sulphur; (9) sodium; (10) iron; (11) chlorine; (12) aluminium; (13) silicon; (14) manganese; and (15) magnesium are all absorbed by the roots from the soil in the form of soluble salts dissolved in water. Of the first three elements, there is nothing further to say, and no great effort on the part of the farmer is required to furnish these essentials. Of the other elements, the next three are most important. All the others are usually found in sufficient quantities in every soil so there is no need to consider them here.

It should be understood that all commercial fertilizers are not necessarily of chemical form. There are many commercial fertilizers which are organic; for instance, bone-meal is a commercial product which is made by grinding bones into powder form. Guano is also a commercial product. It is largely composed of sterilized bird-droppings, which, of course, are also organic. Chemical fertilizers are of a mineral nature, and are inorganic.

Nitrogen promotes leaf and stem growth. This is supplied to the soil by the application of (1) organic manures such as animal dung, leaf mould, green manure, oil-cakes, bazar refuse, guano, etc., and (2) inorganic manures such as nitrate of soda, sulphate of ammonia, nitrate of potash (saltpetre), etc.

Potash promotes production of carbon-compounds, starch, sugar, and cellulose, thereby improving fructification and size of fruits, and hardening and strengthening tissues and framework which nitrogen has thrown into active growth. This is supplied to the soil by (1) organic manures such as wood ash, wood coal, etc., and (2) inorganic manures such as sulphate of potash, muriate of potash, kainit, etc.

Phosphorus promotes production of flowers and fruits, improves their quality, promotes root development, and balances the vigour with nitrogenous manures. This is supplied to the soil by (1) organic manures such as bones, fish, etc.; and (2) inorganic manures such as superphosphates, basic slag, phosphate of potash, phosphate of ammonia, etc.

Many of the natural organic manures are getting more and more difficult to procure, or they contain the necessary elements in such small quantities that it is for these reasons we are obliged to resort to chemical fertilizers; hence my statement that chemical fertilizers are a necessary evil.

Cow manure is practically a complete manure, containing, in addition to nitrogen, both potash and phosphorus, but in small quantities. The same may be said of other animal dungs, bazar refuse, leaf mould, etc. Indeed, a good mixture of all these, in conjunction with the soil, water and air, would not be deficient in any of the elements necessary to plant-life. This should be carefully considered before the farmer, who does not possess the necessary knowledge of chemical fertilizers, is tempted to use them in preference to organic manures. Chemical fertilizers, used in conjunction with farm-yard or other organic manure are, however, the most economical and most profitable method of applying plant-foods to the soil.

It is the nourishing elements in the soil which, when drawn up by the plant, go to increase the yield. A cow incorrectly fed will produce a scanty supply of milk. The productiveness of a flock of hens will suffer if they are not given the right elements necessary for the production of eggs. The plant is in no wise different. It is the simple process of converting one form of food into another. If the proper foods are not supplied, other substitutes cannot be transformed by either beast, bird, or plant into the desired forms.

It is for these reasons essential that the farmer should have some idea of the uses and application of chemical fertilizers. Simply put, it amounts to this:

Apply nitrogen when the plant requires it for growth. There is no use applying a nitrogenous manure to, say, a cauliflower when it is on the point of opening into flower. A quick-acting nitrogenous manure applied to the roots at such a time, will throw the plant into active growth, causing the flower to overdevelop, making it useless for human consumption. Potash aud phosphorus at such a time will improve both the size and quality of the flower, which is the object in view.

Nitrogen is required when the plant is young to encourage strong stem formation and leaf growth, for, unless this is assured at the right time, the flowers and fruits will be proportionately poor specimens, in spite of doses of potash and phosphorus during the advanced stages. If a pumpkin plant, for instance, has been starved of nitrogen during the early stages, there is no use hoping that over doses of phosphorus and potash applied during the flowering period will develop the fruit. A gradual building up of the stem, leaf, roots, flowers and fruits from the earliest stages is what is required.

Similarly, with all vegetation, nitrogenous manures are applied during the early stages of growth to encourage leaf and stem growth, and potash and phosphorus just before the buds are due.

Root vegetables call for no great development above ground, but any stimulation to encourage growth should be given before the edible roots or bulbs are half developed, after which period phosphorus is applied.

Excessive nitrogen tends to throw the plant into luxuriant over-developed growth, and, as a consequence, the formation of flowers and fruits is retarded. When growth is rank and yellowish in colour, nitrogen is needed.

The whole secret of correct application is to fulfil the plant's demands as it requires them, or to have the necessary elements in the soil ready to be drawn on as required.

Spinach, lettuce, and their sister plants, which produce no edible flowers, fruits or roots, call for no large quantities of potash or phosphorus, but nevertheless these are necessary for firm tissue and for supplying sugar, starch, etc., to the leaves and stems.

Always bear in mind that, though the manure is drawn up by the roots, the leaves are the 'stomach' of the plant. It is here that all nourishment is digested and then sent on its way to develop the stem, the roots, the

leaves, the flowers, and the fruits. Unless the plant has abundant and healthy foliage, there is little hope of healthy flowers, fruits, stems, or roots. This is very important.

There is one more important factor to remember when dealing with all fertilizers. They are of two kinds: one in which the elements are readily available in soluble form and which can be absorbed by the roots almost immediately they are applied; whereas the other must undergo certain changes in the soil before the roots can absorb them. It is for this reason fertilizers, both organic and inorganic, must be chosen and applied with care. There would be no use applying a slow-acting phosphorus manure just when the plants are about to form buds. This should have been applied a month previously so as to be available when the plant demands it.

A clayey soil is usually rich in potash; in fact, most Indian soils have sufficient quantities of this element; but an occasional application of lime is necessary to set free the store of potash which lies latent in the soil.

A sandy soil, on the other hand, is usually deficient in potash because it requires a stiff soil to retain it.

Nitrogen and phosphoric acid are deficient in most soils and in all soils under cultivation, unless restored to the soil by frequent applications of manures containing these plant-foods.

Commercial fertilizers may be applied to the soil in three ways:—

(1) Broadcast, i. e., by spreading the fertilizer over the surface and ploughing it into the soil;

(2) Liquid, i. e., by dissolving the fertilizer in water and applying the mixture to the roots of plants by means of a watering-can; and

(3) the "sandwich" process, i. e., by removing a portion of the soil around the roots, applying a small quantity of the fertilizer to each plant, and covering it over with soil. Of the three methods, the second is perhaps the best, but is only possible with very small gardens and with fertilizers that are soluble in water. Of the other two methods, the third is the most economical; and, though it may appear to be the most troublesome, the advantage gained by the use of a smaller quantity of fertilizer justifies its use in preference to the first method.

In all instances, the supplier's instructions should be carefully followed as to the quantity required. Most of the commercial fertilizers are highly concentrated, and on this account they should not come in contact with the stem or foliage of the plants.

The "sandwich" process is conducted as follows: carefully remove the earth around the roots of each plant to a depth of two or three inches and to a circumference a little greater than the spread of the plant above ground. Be sure to leave a collar of earth around the stem so that the fertilizer does not come in contact with the stem. The fertilizer is evenly sprinkled on the channels thus formed and then covered over with the soil previously taken out. Two men should be employed on the work, one preparing the channels to receive the fertilizer, and the other working after him, applying the fertilizer and filling in the channels.

The better plan would be to mix the fertilizer with earth two or three times its own bulk so as to ensure a more even distribution of the fertilizer, and also to lessen the chance of injury to the roots by a too concentrated application.

We draw the attention of our readers to a very useful article on garden **compost** *by Dr. Gilbert Fowler appearing on page 33. It shows a practical way of making a high grade manure in one's own garden or farm. This manure is practically free of all weed-seeds, grubs or eggs of insects and possesses more manurial value than the ordinary garden manure.*

(The following article is reproduced from "The Gardener", January-March 1937.)*

GREEN MANURING

It is seldom that this method of manuring or improving the soil is resorted to in flower gardening, but it is a very useful and economical method and very much recommended in vegetable gardening, especially when an abundant supply of good manure is not available economically.

Green manuring is of special value on poor or exhausted soils that need rejuvenation to produce profitable crops. By green-manuring is meant the ploughing under of green crops grown specially for that purpose. The object of green-manuring is to enrich the soil with nitrogen, add humus to it, improve the physical condition and make available the mineral foods already in the soil. All leguminous plants such as Peas, Beans, Lucerne and hundreds of other plants, including Dhaincha (*Sesbania aculeata*) and wild Indigo are useful for green-manuring.

The special characteristic which makes leguminous crops useful for this purpose is their power to utilize in their growth the free nitrogen of the air, in sufficient quantity to be of agricultural importance. It is well known to all readers that nitrogen is the most important of all elements in the soil, necessary for the growth of all plants. But then the utility of this crop does not end there. Besides gathering sufficient nitrogen from the air for their natural growth, these legumes have the property of fertilizing the soil through their roots with sufficient nitrogen for the following or succeeding crops.

The quantity of nitrogen thus conserved in the roots or the soil depends upon a certain bacteria found in nearly all soils and abundantly so in soils where legumes are repeatedly grown.

* Formerly published by Pestonjee P. Pocha & Sons, Seed Merchants, Poona.

The most economical and commonly grown crop for green-manuring in India is Sunn Hemp (Crotalaria juncea; vernacular, Sanai or Tag) 60-80 lbs. of seeds are needed per acre, though cheap quality Lucerne, Peas, Beans or Lentils where available economically, are often used with great advantage. Green-manuring, besides collecting nitrogen from the air, brings up mineral matter from the sub-soil and stores them in the leaves and stems, and when these crops are ploughed under, these materials accumulate in the surface soil and thus become more available for succeeding crops. When the crop is ploughed under, it adds humus in enormous quantities to the soil which improves the texture of the soil abundantly. Sunn or Tag is a quick growing crop, sometimes the seed germination is within 24 hours and the crop begins to flower within about two months. Just at this time the crop is cut down and buried so that all the nitrogenous and other mineral contents are conserved and returned to the soil. The decaying of the manurial plants liberates the plant food they contain as well as organic acids which dissolve the unavailable mineral elements for future crops.

Usually the seeds are sown in March-April and the crop is ploughed under in the beginning of the rains. The decaying takes about 3-4 months so that the plot of ground is ready for winter-growing crops. [*See also page 20.*]

(The following article is reproduced from "The Gardener", April-June 1937.)*

LIQUID MANURE

The use of liquid manure is so often recommended here and elsewhere that it is taken for granted that most people know what it is and how it is prepared.

It is very simple to prepare but it seems very few know how actually it is done.

One bucket of fresh cow-dung is put into a tub containing about 6 buckets of water. Stir it well once or twice a day for the first two or three days. Then let it stand undisturbed for a day so that all solid matter settles down. Take out all the liquid without disturbing the bottom slush and residue. Dilute the liquid to the colour of weak tea.

The quantity per plant to be used is just as much as the amount of water you may use for ordinary watering per plant. Being stronger and quicker in action than solid manures, it should be applied to plants in an active state, yet in want of a stimulant, but should not be applied to newly transplanted plants. It should be applied every eight or ten days to growing plants.

A day after each application of liquid manure, the surface of the soil should be stirred to a depth of about an inch.

Liquid manure is also prepared by dissolving about an ounce of ammonium sulphate to a gallon of water. Superphosphates and ammonium sulphate in equal parts are also used, dissolved in water, an ounce to a gallon or so, but it is safer to use a more diluted form. A strong mixture is apt to do more harm than good.

* Formerly published by Pestonjee P. Pocha & Sons, Seed Merchants, Poona.

The cow-dung decoction is the safest, cheapest and most easily made of liquid manures to use.

Liquid manure should not come in contact with leaves and should be applied carefully from the spout of a small watering can.

SOIL AND MANURE

One of the many questions frequently asked is, " What is good soil and its composition and how to make out if it is good or not?" A similar question may be asked about manure. Now, it is a recognised fact that the two most important and necessary elements in the making of a garden are soil and manure, without which no garden can subsist. We shall deal with soil first.

Soil—Good soil is a proper mixture of sand (60-70 p.c.), clay (20-30 p.c.), and humus or decayed vegetable matter (10 p.c.) in sufficient quantities. Generally, the soil left in river-beds after a flood is very good, while virgin land could be converted into good soil by having it dug up, ploughed and exposed to the sun. Soils rich in clay require lime to liberate the various substances in the soil and help to fertilise it. It also needs an addition of fine sand and a lot of animal manure containing straw in order to make it light and porous. Good soil when dry is easy to break and pulverise but clayey soil is very hard and will not break up easily. A handful of moist garden soil when pressed hard and formed into a ball will soon detach itself and break up when left open. On the other hand clayey or hard soil will retain its shape.

Manure—Manure when sufficiently old is dark brown or almost blackish in colour with a good, strong, pungent, non-offensive smell. It is light to touch, being soft and spongy. The utility of manure depends on its quality which again varies according to the circumstances under which it is collected. Manure which is decayed under cover, has more nitrogen in it than when it is exposed to the sun or heavily flooded, in which case, the nitrogen gets swept away.

Decayed cow or horse manure contains a large quantity of humus which operates on the soil in two ways—it lightens and at the same time darkens the soil and retains moisture.

Each organic manure has its own chemical value, which depends on how much nitrogen is retained or lost. In this connection we would suggest that our readers refer to the chapter on " Activated Compost" on page 33 for its invaluable information on the subject.

The vegetable matter of farm yard manure is valuable because it preserves the supply of humus which is necessary for soil fertility. The three most important substances—and these are practically the only ones—on which plants feed are Nitrogen, Phosphoric Acid and Potash. To these may also be added lime, though in a lesser degree. A ton of good manure contains about 9 to 15 lbs. of Nitrogen, 9 to 15 lbs. of Phosphoric acid and 4 to 9 lbs. of Potash. These substances in the manure vary and its value depends upon the food, age, breed, condition and treatment of the animals, and also upon how the manure is collected. Nitrates encourage the development of stems and leaf growth and Phosphates fill out the grain. Potash contributes to the formation of Hydrocarbons such as sugar, starch and cellulose.

FERTILIZERS OR CHEMICAL MANURE

These are added to the soil to make up for a particular deficiency in the soil, as these are highly concentrated forms of manure. They should be used judiciously.

In our opinion these are stimulants or tonics to the crops and are best used in the later stages of growth. But the fact remains that these fertilizers can never take the place of good farm yard or stable manure entirely.

A complete fertilizer contains all the three substances, viz., Nitrogen, Phosphoric Acid and Potash. But some soils do not require all these three substances.

There are some crops that will take up all the Nitrogen from the soil. On the other hand leguminous crops—like Peas, Lentils, Lucerne—leave the soil richer in Nitrogen.

We shall give here only general directions as regards the kind of fertilizers likely to be of use in different soils.

Sandy soil is generally deficient in all the three substances named above. Clayey soil is abundantly supplied with Phosphoric Acid and Potash, specially the latter. Lime-stone soils generally contain sufficient Phosphoric Acid. Black soils are sufficiently rich in Nitrogen but deficient in Phosphoric Acid and Potash. The effect of Nitrogenous fertilizers is chiefly to promote the growth of stems and leaves of plants, and to retard the development of flowers and fruits. An abundance of Nitrogen in the soil is indicated by deep green foliage. If Nitrogenous fertilizers are applied to plants about the time they shoot blooms, new stem and leaf growth is likely to result and the flowering period is checked. Too much Nitrogen promotes leaf growth and deteriorates the quality of flowers.

Nitrate of soda and Sulphate of ammonia are the most highly concentrated forms of Nitrogenous fertilizers. Nitrate of soda readily dissolves in water and is immediately available to plants. Its effects may sometimes be seen even within 24 hours. Nitrate of soda is one of the most powerful nitrogenous fertilizers when properly utilised. Good results are obtained when it is applied in 2 or 3 doses during the growth of a plant. When used in excess and more than the actual need of the plant, it is easily washed away as it does not adhere to the soil, and it is certainly a monetary loss.

100 lbs. of Nitrate of soda contains about 16 lbs. of Nitrogen, while 100 lbs. of Sulphate of ammonia which is a more concentrated form of fertilizer, contains about 20 lbs. of Nitrogen. It acts less rapidly than Nitrate of soda, though it is quickly soluble in water. As it gets diffused in the soil, it is more useful in wet weather.

Phosphatic Fertilizer—No plant will ever grow without Phosphorus and is intimately connected with the productivity of seeds. When rocks, bones or other material containing insoluble Phosphoric Acid are treated with Sulphuric Acid, the Phosphoric Acid is rendered soluble in water and is readily available to plants. Such Phosphates are known as Super Phosphates and are the most valuable forms of Phosphatic Fertilizers. Phosphatic Fertilizers are not washed away by rains and are applied to soils sometimes even before the crops are sown.

Bone meal contains about 3 to 5% of Nitrogen and 20 to 25% Phosphoric Acid; the finer the bones are ground, the more readily do they decay in the soil thus making the Phosphoric Acid in them available to plants.

Potash Fertilizer—Muriate of Potash is largely a purified product of German mines containing about 50 to 53% of actual Potash. It is largely used for all farm crops except Tobacco, Potato and Sugar-beet.

Sulphate of Potash is also a product of German mines, and contains about 48 to 50% of Potash.

Ashes contain a fair amount of Potash and is one of the best forms for the use of plants. The useful forms are wood, cow-dung and lime kiln-ashes. Coal ashes are practically useless as regards Potash.

Dried Blood—This is also one of the important organic nitrogenous fertilizing substances. It is rich in Nitrogen, decays rapidly in soil and hence is quickly available for the use of plants.

(The following article is reproduced from "The Gardener", April-June 1939 by kind permission of the author.)*

MANURIAL PROGRAMME

FOR THE GARDEN

By I. A. SAYED, B. Ag., *College of Agriculture, Poona.*

As in animal life food is essential for growth, so also plant life has to be nourished in order to sustain and encourage its growth till the completion of its life cycle. Nourishment to plants is provided by the addition of manures, organic or inorganic. Organic manures are natural manures and include decomposed animal matter, animal dung, blood, bones, etc., while inorganic manures are artificially prepared and include salts of ammonium, potassium, sodium and their combinations. The residual effect of organic manures is more lasting.

The system of manuring and the dose differ considerably in ornamental plants as compared with fruit or agricultural crops. The delicacy of their growth or bloom demands a very judicious selection of manure with a view to obtain the best effect. Ornamental plants are divided into a number of classes according to habit of growth, life cycle and growth requirements. Therefore, the manurial programme for these different classes is very variable and it is indeed very difficult to evolve any definite manurial formulæ to suit their requirements. The quality and quantity of manure have to be adjusted according to the nature of the plant and the way in which it is grown.

The manurial programme as outlined below for the different classes of ornamental plants in a garden will be found useful. It may need, if at all, a slight modification as much depends upon the whim of the grower and the object he has in view.

* Formerly published by Pestonjee P. Pocha & Sons, Seed Merchants, Poona.

Annuals—A good number of flowering annuals can be cultivated with success in pots for which the following compost is recommended:—

Alluvial soil, 2 parts; Sand, 1 part; Leaf-mould, 2 parts.

Small handfuls of good and well rotted farm-yard manure should be given as top-dressing when needed.

The following general compost will also be found beneficial to most annuals:—

Leaf-mould, 30 parts; Red earth, 40 parts; Farm-yard manure, 40 parts.

For bedding plants, after the site has been well prepared, well rotted farm-yard manure, leaf-mould and thoroughly decayed vegetable refuse should be worked into the beds to a depth of 12 inches. During growth and blossoming, plants benefit considerably by weekly dressing with liquid manure made from cow-dung, which should not be allowed to touch the foliage.

For hardy annuals (those which can be sown directly in the open ground where they are to grow, e. g., sweet peas, cornflower, calendula, coreopsis, eschscholtzia, etc.), farm-yard manure at the rate of 2½ cwts. per 20 square feet may be worked in the soil. When growing half-hardy annuals (those which can either be sown directly or transplanted, e. g., arctotis, gerbera, gomphrena, nasturtium, gaillardia, larkspur, etc.), in pots, the following compost may be used.

Loam, 4 parts; Leaf-mould, 1 part; Farm-yard manure, ½ part.

Shrubs—For growing shrubs in the ground, farm-yard manure at the rate of 4 cwts. per 20 square feet may be applied when cultivating the soil. Top dressing of leaf-mould should be given during growth and blossoming. Sometimes the space for planting shrubs is dug into a trench which is filled with one part of river soil and one part of farm-yard manure.

Creepers—Creepers in general receive the same manurial treatment as mentioned for shrubs. Creepers in the ground receive manure once in two years while those in pots receive annually.

Bulbs—Bulbs in pots thrive splendidly in a compost consisting of the following:—

Leaf-mould, 2 parts; Sand, 1 part; Charcoal, 1 part; A little mortar and chips of rotten or half burnt wood.

When grown in the ground, the soil should be enriched with a good amount of leaf-mould. Bone-meal is also very beneficial and should be added round the bulbs at the rate of 2 ozs. to the square yard and thoroughly worked in. Besides, an equal amount of superphosphate may be added with advantage.

Roses—Roses in pots should be reared in a mixture composed of:—

Loam or alluvial soil, 2 parts; Leaf-mould, 1 part; Farm-yard manure, 1 part.

This should be supplemented with the application of cow-dung liquid twice a month as it is conducive to free flowering. Liquid manure should be very weak and never strong. The method of preparing liquid manure, which is very simple, consists of first preparing stock solution by using one bucket of fresh cow-dung to six buckets of water. This is mixed well and stocked in a barrel for a week. The solution is then carefully strained to remove chaff and coarse material. This solution should be diluted before use to such an extent that it assumes the colour of weak tea.

In case of ground cultured roses, the pits dug out to receive plants are filled with well rotted farm-yard manure and leaf-mould in equal proportion in addition to some old mortar or rubbish. To the compost are also added ½ lb. of bone-meal and charcoal dust. After the rest period, the individual plants receive 2 to 4 baskets of farm-yard manure mixed in equal proportion with old horse manure. Sometimes after the bed is prepared, bone-meal at the rate of 1 lb. to a square yard is added to enrich the soil. Castor cake is also a useful manure for roses. Another manure which can be used with advantage is as follows:—

Bone-meal, 12 parts; Sulphate of potash, 10 parts; Sulphate of ammonia, 5 parts; Gypsum, 1 part. This mixture should be used at the rate of ½ a lb. per plant.

Palms—For growing palms successfully the following compost is recommended:—

Leaf-mould, 1 basket; Red earth, 2 baskets; Farm-yard manure, 2 baskets; Mortar and charcoal, ½ basket, *or*,

Leaf-mould, 2 parts; Garden soil, 1 part; Sand, 1 part; River silt, 1 part.

Ferns and Begonias—Ferns and begonias thrive best in the following compost:—

Leaf-mould, 4 parts; Red earth, 2 parts; Charcoal, 1 part; Mortar, 1 part; Sand, a little; *or*

Loam, 2 parts; Sand, 1 part; Fibre refuse, 1 part; Leaf-mould, 1 part; Moss chopped, 1 part (if available).

Generally, the potting compost for growing begonias consists of any light, fairly rich garden soil mixed with an equal quantity of well rotted leaf-mould, fine sand and charcoal dust.

Window Boxes and Hanging Baskets—These are very common in homes devoid of sufficient space to maintain a garden. Plants in boxes or baskets thrive very well when a light sprinkling of bone-dust or a thick coating of well rotted farm-yard manure properly sifted is given after the plants have filled the earth with roots.

Lawns—Several manurial treatments are recommended for lawns but the general practice consists of working into already tilled soil 30 cart-loads of decayed farm-yard manure per acre. Where the use of artificials is convenient, 2 cwts. of superphosphate of lime, 1 cwt. of Peruvian guano, and 2 to 4 cwts. of bone-meal mixed together form an excellent dressing. This dressing is sufficient for an acre.

To keep lawns healthy and in prime condition, it is a practice in western countries to apply sulphate of ammonia at the rate of 3 lbs. per 1,000 square feet every fortnight from April to September. This should be mixed with 3 or 4 times of well sifted garden soil and broadcast by hand evenly. If sulphate of ammonia is not available, use weak liquid manure (see p. 27) with soot, and you will be surprised at the excellent result obtained. During the winter, a mixture of dry pit-sand, good loam soil and farm-yard manure should be applied in three dressings, the first in November and the second at a convenient interval during the winter. Each dressing should be as much as can be applied without spoiling the appearance of the lawn. Refer to the article on Lawns in part V for further hints on fertilizing lawns.

(*Note:*—While using farm-yard manure, particular care should be taken that it does not contain any weed seeds. These are bound to contaminate good weed-free lawns. Use of sulphate of ammonia on lawns is also recommended in this country.)

Activated Compost

By Gilbert J. Fowler, D. Sc., F. R. I. C.

It is the custom of most gardeners to utilise the fallen leaves and other plant residues in the garden for the manufacture of leaf mould by storing these materials in a pit, sometimes together with a little cow dung to assist the process of rotting down into leaf mould to be used for next year's manure supply. In this way, some of the plant food which has been taken from the soil by the growing plant is returned for next season's growth.

The chief constituents of plant food are the elements nitrogen, phosphorus and potash. These elements exist in various combinations in plant and animal residues.

NITROGEN occurs in animal refuse, e.g., cattle dung and urine and also in leguminous plants such as peas and beans and the leaves of many trees.

PHOSPHORUS is present in animal refuse.

POTASH occurs in the stems and twigs of plants and consequently in wood ashes.

All these elements, therefore, are available in the waste materials of an ordinary garden and cowshed. In addition, these materials when fermented or "rotted", furnish a brown residue known as *humus* which is essential to the healthy growth of plants and the proper tilth of the soil.

The ordinary method of making leaf mould as above referred to takes a long time in the course of which some of the necessary food elements may be lost, either by escaping into the air as in the case of nitrogen, or by being washed away into the soil. Moreover, at no time does the temperature necessarily rise very high and so the larvæ of insects are not destroyed and seeds of weeds may still be present to germinate later when the manure is put into the soil.

The product known as Activated Compost consists of the same elements but is made by a process which is much more rapid than the old leaf mould pit, which therefore obviates the loss of useful plant food and entails an exceptionally high fermentation temperature, which eliminates all noxious constituents from the resulting compost.

A further advantage of this new method is that the composition of the ultimate manure can be controlled within limits and if necessary the percentage of the three important plant food elements–nitrogen, phosphorus and potash can be increased by suitable additions of "artificials": thus nitrogen may be added as sulphate of ammonia, and other suitable artificial compounds of nitrogen; phosphorus as bone meal or rock phosphate. Potash is seldom in defect since it exists in adequate amounts in most plant residues, but if necessary can be added in any of the forms of mineral potash fertilisers on the market.

A further advantage of Activated Compost is that if carefully prepared it may show an actual increase of nitrogen over what was originally present in the materials used, owing to what is known as fixation of this element from the atmosphere by certain organisms present in the raw materials used, which have the power of combining with or fixing the free nitrogen of the atmosphere.

The new product is known as Activated Compost since the principle of activation is used in its preparation according to which a mass of actively fermenting material is first prepared to which fresh unfermented waste products can be added, the fermentation of which then takes place in much less time than when the reaction has to be started each time *de novo*. This principle is indeed made use of frequently by the ryot who finds that the rotting down takes place much more rapidly if a little of the last year's product is left in the pit to start the new fermentation.

By the new process instead of rotting down the material in a pit it is piled on the surface of the ground in a heap about 2 feet high and 3 feet wide at the base. These heaps are moistened with a solution of cow dung and urine to start the fermentation which soon produces a high temperature. The mass has to be stirred from time to time to ensure adequate aeration. The conditions, in fact, are closely analogous to those required in keeping an ordinary fire alight. When the temperature begins to fall a portion of the first heap can be withdrawn and used for starting a second heap and fresh material equivalent to the amount removed added to the first heap. The process thus becomes continuous and results in a series of heaps with fresh material at one end and heaps of partially unacted upon material in the middle, and finally a heap of material completely broken down into a smooth brown humus ready for storage or to be used at once as a fertiliser. From time to time the heaps must be moistened with further doses of the cow dung and urine solution, since, if allowed to become dry, fermentation ceases; but they must never be allowed to get sodden. To protect the heaps from rain a thatched shed should be put up, or the heaps may be covered by cheap rush matting. Protection from sun is not necessary.

With the foregoing general explanation the following detailed instructions may be better understood.

DETAILED INSTRUCTIONS

Collect any material such as weeds, grass, leaves (green and dry), and other garden and household rubbish including garbage and ashes. Out of the material form a heap about 6 feet long, 3 feet wide at the base, and 2 feet high, chopping any long stalks into small bits.

Material

Take a basketful or a maund of fresh unmixed cow dung and make it into a thin mixture with urine and water. Night soil may also be used instead of cow dung. A small quantity of bonemeal may be added with advantage.

Solution

With this solution moisten every portion of the heap thoroughly by sprinkling and stirring. Keep the heap moist from day to day until the temperature rises and then begins to fall decidedly and the material shows signs of disintegration and crumbles between fingers when handled. It is necessary to take the temperature of the material in the heap frequently. In Bangalore it rises up to about 50° to 70°C. This fermented material constitutes the "Starter" or "Activator."

Activator

At this stage remove a quarter of the heap of the activator (the first heap), and pile it about a foot away from the first heap; this pile is the beginning of the second heap. Make up the first heap to its original size with fresh material. This fresh material should be thoroughly mixed with the rest of the first heap. How this can best be done is a matter for local convenience. Both the first heap and the first quarter of the second heap should be kept moist but not wet by further sprinkling with solution.

Process

The temperature of the first heap will again rise. As it begins to drop, remove a quarter of the heap again and mix it with the first quarter of the second heap which now becomes half the size of the first heap. Fill up the first heap as before with fresh material. Repeat these operations until the second heap equals the size of the first. The next operation will be to start a third heap by taking a quarter from the second heap, making up the second heap to its full size with a quarter from the first heap, which is again brought to its full size by a further addition of raw material. This process may be continued until the third heap is equal in size to the first and second heaps. It will be seen that fresh raw material is added only to the first heap.

Compost

It may be that by the time the third heap is complete and has been allowed a short period of final fermentation, that the material will be ready for use, as is shown by the complete disintegration into a smooth humus of all the leaves and plant fibres. If this is so, take away a quarter from the third heap, pass it through a screen to remove stones and twigs, and either store it in a heap or use it at once. Fill up the third heap with a quarter from the second heap as before.

If, on the other hand, the decomposition does not appear complete, begin a fourth heap in the same way taking a quarter from the third to start it. It is seldom that more than four heaps will be required. When this stage is reached it should be possible, at intervals of not more than a fortnight, to take away a quarter from the fourth heap for use, fill up the fourth heap

from the third, the third from the second, the second from the first and the first with raw material.

Throughout the fortnight all the heaps should be kept moist by sprinkling further additions of the solution on to the heaps. It will be found that as the heaps become more and more ripe, less solution will be required to keep them moist as the material naturally retains more moisture so that the first heap will always require the most and the last heap the least, no heap must be allowed to become sodden.

In course of time it will probably be found that the fermentation becomes more active owing to the development of the organisms specially suited to the local conditions. It may then be possible to take away half of each heap at a time instead of a quarter.

The time required to prepare the first heap or Activator will naturally vary according to the character of the material dealt with, (whether soft, such as grass, weeds and soft leaves and stems of plants; or tough leaves such as mango, Java fig, etc.), and the weather conditions; it may take less than a week, but should not exceed a month.

The last heap should be ready in about 3 months from the start.

The foregoing instructions were drawn up having in mind chiefly a normal moderate-sized garden. For large-scale work, e. g., when dealing with Municipal refuse and nightsoil, the total area and volume of the heaps required will need to be increased. The heaps may be lengthened indefinitely but in general the height should not exceed three feet or the base four feet. For large-scale work it will be convenient to divide the heaps *longitudinally* and to remove *half* a heap at a time rather than a quarter.

If further explanation or advice is necessary in the application of the above instructions, reference may be made to Dr. Gilbert Fowler, Mackay's Gardens Annexe, Graemes Road, Cathedral P. O., Madras, S. India.

Permanganate of Potash as a Humus Former

"All over the world there is a marked shortage of humus manure. Mr. Greening * decided to try the effect of potassium permanganate on a heap of mixed garden refuse. The heap measured one cubic yard. On July 23, 1936 the heap was soaked with 6 gallons of a solution containing 3 ozs. of the chemical, and lightly covered with sifted soil. A month later the heap was turned and treated with 3 ozs. of permanganate dissolved in 3 gallons of water. On August 26 and September 1, respectively, the heap was again treated with the chemical, on each occasion 2 ozs. being dissolved in two gallons of water.

"About the middle of August decomposition set in, and a month later the heap was ready for use as an organic manure. Coming from such an unquestionably reliable source, there can be no doubt as to the value of this discovery. The acute shortage of stable manure, due to the triumph of the motor over the horse, has rendered necessary the evolution of some reliable substitute. Surely nothing simpler or more economical will ever be found."

* Mr. C. B. Greening, B. Sc., Royal Horticultural Society, Wisley, England.

PART III

FLOWERS

Their Culture, Diseases & Pests

CONTENTS OF PART III

	Page
Hints on Raising Flowers	38
Antirrhinum (Snapdragon)	43
Asters	43
Balsam	46
Begonias	47
Canna	49
Carnation	53
Chrysanthemum	54
Cosmos	57
Dahlia	57
Delphinium	67
Gladiolus	67
Gloxinia	69
Nasturtiums	69
Pansies	71
Petunia	72
Phlox	73
Sweet Peas	74
Zinnia	76
Flowers from Seeds for Partially Shady Places	77
Rock Plants from Seeds	77
Climbers and Creepers from Seeds ...	78
Plants for Edgings	78
Fragrant Flowers	78
Plants for Foliage Effect	78
How to keep Flowers Fresh	78

HINTS ON RAISING FLOWERS

Sowing problems differ greatly in different parts, and local practice proves to be generally a fairly good guide. For all that, the general notes given below while they are not meant to be taken literally may be found useful as a working basis.

Since the one most important factor determining the time for sowing flower seeds in India is the rainfall, we give below separate lists of flower seeds which can be grown in different parts of India (or countries with similar climate) with varying degrees of rainfall. Very few flowering annuals can thrive in places with a heavy rainfall. But where the rainfall is light or evenly distributed, quite a large number of European annuals can be easily cultivated, provided the soil is light or porous, the drainage good, and no water is allowed to stagnate near roots. It may be noted that the flowers which are suitable for growing in heavier rainfall can also be grown in places with a lighter rainfall.

It may be noted that higher elevation compensates, in part, for heavier rainfall. So on hilly places where rain water has no chance of stagnating near roots and where the atmosphere is cooler and cleaner, a larger variety of annuals can be grown.

For the guidance of those who do not know in which seasons different flower seeds are to be sown, we give below different lists, which we trust will be useful to our readers.

LIST No. "R1."

(For light rainfall.)

The undermentioned seeds may be sown in the beginning of the rainy season or even one or two weeks before the rains have started (provided, ofcourse, that the weather is not too hot), *in places where the average rainfall during the rainy season is light*—say not over 30 inches. In this class of plants we have included some winter-flowering annuals which are known to grow successfully during the rainy season (June to end of Sept.) in the Deccan, but which it must be noted, cannot stand a long continued spell of wet weather. Light sandy soil and perfect drainage are essential for such plants if grown during the rains. We have marked all such with a star * in the list given below so that those who want to be quite sure about their annuals flowering in the rains, may omit them from their list of rainy season annuals. In the Uttar Pradesh, Punjab and similar places where the months of July to September are hot, though a precipitation of rainfall is experienced during these months, it is advisable to grow such annuals as winter annuals only, putting them down in Sept. or Oct.

Abronia, Abutilon, Acacia, Achillea, Agapanthus, Agathea, Ageratum, *Alyssum, Amaranthus, Amaryllis, Ampelopsis, Anchusa, Antigonon, *Antirrhinum (*Snapdragon*), Aquilegia (*Columbine*), Arctotis, Argemone, Aristolochia, Asparagus, Aster, Balloon Vine, Balsam, Begonias both Fibrous and Tuberous-rooted, Bidens, Bignonia, Blanket Flower (*Gaillardia*), Blue Lace Flower (*Didiscus*), Browallia, Cacalia, Cactus, Calendula, Calla, Calliopsis (*Coreopsis*), Campanula (*Canterbury Bells*), *Candytuft, Canna, Carnation, Carthamus, Celosia, *Centaurea, Cerastium, Chalk

Plant (*Gypsophila*), Chrysanthemums (all), Clematis, Cleome, Clitoria, Cobæa, Cockscomb, Coleus, Columbine (*Aquilegia*), Commelina, Cone Flower (*Rudbeckia*), Convolvulus, *Cornflower (*Centaurea*), Cosmedium, Cosmos, Cyclamen, Cynoglossum, Cyperus, Dahlia, *Daisy Double, Daisy Shasta or Marguerite, Daisy Michaelmas, Daisy Blue-eyed African (*Arctotis*), Daisy Barberton (*Gerbera*), Daisy Ox-eye (*Leucanthemum*), Datura, Delphinium, *Dianthus (Pinks), Didiscus (*Blue Lace Flower*), Dolichos, Erysimum (*Siberian Wallflower*), Euphorbia, Everlasting Flower (*Helichrysum*), *Flax (*Linum*), Floss Flower (Ageratum), Forget-me-not, Freesia, Gaillardia, Gamolepis, Gaura, Geranium, Gerbera, Gladiolus, Globe Amaranth (*Gomphrena*), Gloxinia, Gourds Ornamental, Grasses Ornamental, *Gypsophila, Helenium, Helianthus (*Sunflower*), Helichrysum (Everlasting), Heliotrope, Hibiscus, Hollyhocks, Humulus, Hyacinthus, Impatiens, Ipomœa, Ipomopsis, Jacobæa, Kochia, Kudzu Vine, Ladies' Lace, Lantana, Lavatera, Lavender, *Leptosiphon, Leucanthemum, *Linum, *Lobelia, Lychnis, Marigold, Martynia, Marvel of Peru (*Mirabilis*), *Matricaria, Maurandia, Medeola (*Smilax*), Mimosa, Mina, Morning Glory (*Convolvulus and Ipomœa*), Myosotis, *Nasturtium, Nicotiana, Oenothera, Passiflora (*Passion Flower*), Pentstemon, Perilla, *Petunia, *Phlox, Physalis, *Pinks (*Dianthus*), Polygonum, *Portulaca, *Ranunculus, Ricinus (*Castor Plant*), Rosa, Rudbeckia, Salvia, Sanvitalia, Senecio (*Jacobœa*), Sensitive Plant (*Mimosa*), Smilax, *Snapdragon (*Antirrhinum*), Solanum, Spider Flower (*Cleome*), Sunflower, *Sweet Sultan (*Centaurea*), Tagetes (*Marigold*), Tecoma, Thunbergia, Torenia, *Tritoma, *Tropæolum (*Nasturtium*), Verbena, Vinca, *Viola, *Wallflower, Xeranthemum, Zea, Zinnia.

LIST No. "R2".

(For moderate rainfall)

The undermentioned seeds can be sown as mentioned in "R1" but in places where the rainfall is usually heavier—say upto 50 inches during the rainy season:

Abutilon, Acacia, Agapanthus, Ageratum, Amaranthus, Amaryllis, Anchusa, Antigonon, Argemone, Aristolochia, Asparagus, Aster, Balloon Vine, Balsam, Begonia Fibrous-rooted, Bignonia, Blanket Flower (*Gaillardia*), Cactus, Calla, Calliopsis (*Coreopsis*), Canna, Carthamus, Celosia, Chrysanthemum Japanese, Cleome, Clitoria, Cockscomb, Coleus, Cone Flower (*Rudbeckia*), Convolvulus, Cosmos, Cyperus, Dahlia, Daisy Barberton (*Gerbera*), Datura, Delphinium, Floss Flower (*Ageratum*), Gaillardia, Geranium, Gerbera, Gladiolus, Globe Amaranth (*Gomphrena*), Gloxinia, Gourds Ornamental, Helenium, Helianthus (*Sunflower*), Hibiscus, Impatiens, Ipomœa, Kochia, Lantana, Marigold, Martynia, Marvel of Peru (*Mirabilis*), Mimosa, Mina, Morning Glory (*Convolvulus and Ipomœa*), Passiflora (*Passion Flower*), Perilla, Ricinus (*Castor Plant*), Rudbeckia, Salvia, Sensitive Plant (*Mimosa*), Solanum, Spider Flower (*Cleome*), Sunflower, Tagetes (*Marigold*), Tecoma, Torenia, Verbena, Vinca, Zea, Zinnia.

LIST No. "R3."

(For heavier rainfall.)

The undermentioned seeds can be sown as mentioned under "R1," but in places with heavier rainfall than 50 inches.

Agapanthus, Ageratum, Amaranthus, Amaryllis, Antigonon, Aristolochia, Asparagus, Balsam, Begonia, (Fibrous-rooted), Bignonia, Blanket Flower (*Gaillardia*), Calliopsis (*Coreopsis*), Canna, Carthamus, Celosia, Cleome, Clitoria, Cockscomb, Coleus, Cone Flower (*Rudbeckia*), Convolvulus, Cosmos, Cyperus, Dahlia, Daisy Barberton (*Gerbera*), Datura, Floss Flower (*Ageratum*), Gaillardia, Gerbera, Gladiolus, Globe Amaranth (*Gomphrena*), Gloxinia, Helenium, Helianthus (*Sunflower*), Impatiens, Ipomœa, Kochia, Lantana, Marigold, Martynia, Marvel of Peru (*Mirabilis*), Mimosa, Morning Glory (*Convolvulus and Ipomœa*), Passiflora (*Passion Flower*), Perilla, Ricinus (*Castor Plant*), Rudbeckia, Salvia, Sensitive Plant (*Mimosa*), Spider Flower (*Cleome*), Sunflower, Tagetes (*Marigold*), Torenia, Verbena erinoides (Moss or Perennial Verbena), Vinca, Zinnia.

Ofcourse it is understood that all plants which can be grown in places with **heavier rainfall** can also be grown with equal success, in places with **lighter rainfall;** thus, annuals like Balsams, Zinnias, etc., which are listed above under R3 can also be grown quite successfully everywhere else during the rains.

LIST No. "W."

(Winter flowering Annuals.)

These annuals flower during the winter. They are generally put down on the plains in September-October, mostly in October, depending on the condition of the weather; in some places, (like the Island of Bombay) as late as the end of October or beginning of November. Then they bloom in the cold months of December to March, according as they are sown early or late. Among the winter plants, biennials and perennials such as Aquilegia, Calceolaria Campanula, Cineraria, Digitalis, Leucanthemum, Pentstemon, Primula, Shasta Daisy, etc., which take a longer time to come into bloom than annuals, should be sown as early as possible from August to October, so that they may have enough time to be established and to flower before the summer comes on. These few mentioned above are cool-weather plants and do not generally do well on the plains of S. India. But on all Hill Stations and in the North (even on the plains) they do well.

Abronia, Abutilon, Achillea, Acroclinium, Adonis, Agathea, Ageratum, Agrostemma, Alonsoa, Alyssum, Ammobium, Ampelopsis, Anagallis, Anchusa, Anemone, Anthemis, Antigonon, Antirrhinum, Aquilegia, Arctotis, Asperula, Aster, Aubretia, Bartonia, Begonias both Fibrous and Tuberous rooted, Bidens, Bignonia, Blanket Flower (*Gaillardia*), Blue Lace Flower (*Didiscus*), Brachycome, Browallia, Cacalia, Calandrinia, Calceolaria, Calendula, Calla, Calliopsis (*Coreopsis*), Callirhœ, Campanula (*Canterbury Bells*), Candytuft, Canna, Carnation, Centaurea, Centranthus, Cerastium, Chalk Plant (*Gypsophila*), Chrysanthemums (all), Cineraria, Clarkia, Clematis, Clintonia, Cobæa, Collinsia, Columbine (*Aquilegia*), Commelina, Corn Flower (*Centaurea*), Cosmedium, Cyclamen, Cynoglossum,

Daisy Double, Daisy Shasta or Marguerite, Daisy Swan River (*Brachycome*), Daisy Barberton (*Gerbera*), Daisy Blue-eyed African (*Arctotis*), Daisy Michælmas (*Perennial Aster*), Daisy Ox-eye (*Leucanthemum*), Delphinium, Devil-in-a-Bush (*Nigella*), Dianthus, Dictamnus, Didiscus, Digitalis, Dimorphotheca, Dolichos, Erysimum, Eschscholtzia, Eucharidium, Euphorbia, Eutoca, Everlasting Flower (*Helichrysum*), Flax (*Linum*), Floss Flower (*Ageratum*), Forget-me-not (*Myosotis*), Fox Glove (*Digitalis*), Freesia, Gaillardia, Gamolepis, Gaura, Geranium, Gerbera, Geum, Gilia, Gilli Flower (*Stock*), Gladiolus, Gloxinia, Godetia, Grasses Ornamental, Gypsophila, Heart's Ease (*Pansy*), Hedysarum, Helenium, Helichrysum (*Everlasting*), Heliotrope, Heuchera, Hibiscus, Hollyhock, Honesty (*Lunaria*), Humulus, Hunnemannia, Ice Plant (*Mesembryanthemum*), Impatiens, Ionopsidium, Ipomœa, Ipomopsis, Jacobæa, Kaulfussia, Kudzu Vine, Ladies Lace, Lantana, Larkspur, Lavatera, Lavender, Leptosiphon, Leptosyne, Leucanthemum, Limnanthes, Linaria, Linum, Lobelia, Lunaria (*Honesty*), Lupins, Lychnis, Malcomia, Marvel of Peru (*Mirabilis*), Mathiola, Matricaria, French Marigold, Maurandia, Medeola (*Smilax*), Mesembryanthemum, Mignonette, Mimulus, Mina, Myosotis, Nasturtium, Nemesia, Nemophila, Nicotiana, Nigella, Nolana, Oenothera, Pansy, Papaver (*Poppy*), Passiflora (*Passion Flower*), Pentstemon, Perilla, Petunia, Phacelia, Phlox, Physalis, Pinks (*Dianthus*), Polygonum, Poppy, Portulaca, Primula (*Primrose*), Pyrethrum, Ranunculus, Rhodanthe, Ricinus (*Castor Plant*), Rosa, Rudbeckia, Salpiglosis, Salvia, Sanvitalia, Saponaria, Scabiosa, Schizanthus, Senecio (*Jacobœa*), Silene, Smilax, Snapdragon (Antirrhinum), Solanum, Solidago, Statice, Stock, Sweet Peas, Sweet Sultan (*Centaurea*), Sweet William, Tecoma, Thunbergia, Tritoma, Tropæolum (*Nasturtium*), Ursinia, Venidium, Verbena, Vinca, Viola, Viscaria, Wallflower, Whitlavia, Xeranthemum.

LIST No. "H"

(Plants suitable for flowering during the hot weather or summer.)

The following annuals are generally put down late in the winter, about January-February, especially in Northern India and Bengal and also in June-July (which are hot months in Northern India, on the plains.)

Amaranthus, Argemone, Balsam, Blanket-Flower (*Gaillardia*), Calliopsis (*Coreopsis*), Canna, Celosia, Cleome, Clitoria, Cockscomb, Convolvulus, Cosmos, Datura, Gaillardia, Globe Amaranth (*Gomphrena*), Gourds Ornamental, Helianthus (*Sunflower*), African Marigold, Martynia, Marvel of Peru (*Mirabilis*), Mimosa, Morning Glory (*Convolvulus and Ipomœa*), Petunia, Portulaca, Ricinus (*Castor Plant*), Sensitive Plant (*Mimosa*), Spider Flower (*Cleome*), Sunflower, Torenia, Verbena erinoides, Vinca, Zea, Zinnia.

Madras and Southern India.

In Madras and Southern India, where the rainy season is quite different from that of other parts of India, most of the European annuals are sown on the plains about Sept.-Oct., especially soon after the heavy rains in October. But such flowers as Balsams, Zinnias, etc., which can be grown in heavy rains (given under list marked "**R3**") may be sown any time between August and December.

Hill Stations of Southern India.

On the Hills of Southern India, like the Nilgiris and the Shevaroys, the problem is a little different. The annual precipitation is divided over a greater period and the total rainfall is not very heavy. A larger variety of flowers of temperate regions can be successfully grown here. The usual time to sow here is from March to May. Also in December-January to flower during the spring and summer.

Hill Stations of Northern India.

Hill Stations of Northern India and Bengal. In short notes such as these, much cannot be said of the times, etc., for sowing. Generally, seeds of many annuals for flowering during late summer and autumn, are sown during March, April and May. But there are many other flowers, more or less hardy, which can also be sown in the Autumn months (August to Oct.) to flower during the spring and early summer. Many of these require some protection from severe weather during the winter. The following is a small list of them for the guidance of our friends: Ampelopsis, Antirrhinum (*Snapdragon*), Aquilegia (*Columbine*), Aster, Bignonia, Calceolaria, Campanula, (*Canterbury Bells*), Candytuft, Carnation, Cineraria, Cobœa, Cyclamen, Double Daisy, Delphinium, Eschscholtzia, Forget-me-not (*Myosotis*), Gaillardia, Geranium, Gladiolus, Heuchera, Humulus, Impatiens, Larkspur, Leptosiphon, Leucanthemum, Lobelia, Mignonette, Mimosa, Mimulus, Myosotis, Oenothera, Pansy, Passiflora, (*Passion Flower*), Petunia, Polygonum, Poppy, Primula (*Primrose*), Salpiglosis, Scabiosa, Schizanthus, Silene, Sweet Peas, Sweet William, Violas, Wallflower.

But such annuals as Balsams, Zinnias and others which are generally grown on the plains as rainy season annuals (given under list **R3**), are best sown on the Hills of Northern India from April to June. Balsam, which is one of the quickest to flower from seeds, can be sown at any time from April to middle of August.

Hill Stations of Central India.

On the Hills of Central India, such as Pachmarhi and Mount Abu, all rainy weather seeds (**R2** and **R3**) can be grown during the rains (June to September). These are best put down about beginning or middle of June. Also, if flowers are needed during the winter, almost all the winter annuals can be sown in September-October, as soon as the heavy rains have ceased. Among these the following being hardier, generally succeed well during the winter: Sweet Peas, Clarkias, Nasturtiums, Asters and Poppies. Most of the other Winter annuals will not succeed well unless protection is given to the plants against heavy frost which is experienced during those months. But if a show of flowers is needed during the summer months of March, April and May, seeds may be put down about December-January. Such seeds may consist of any of the annuals given in the list under **R1** and **W**. Seeds of late blooming biennials and perennials are best put down in October-November.

Hill Stations of Western India.

On the Hills of Western India, like Mahableshwar and Matheran, where the rainfall during the months of June to September is very heavy, few of the rainy season annuals can be grown successfully during the rains, but all sorts of winter and other annuals can be grown just the same as on Hill Stations of Central India.

FLOWERS

ANTIRRHINUM

(Snapdragon.) Family, *Scrophulariaceæ.*

Press the side of the flower and the dragon's mouth will open, closing when released. This is a perennial but is usually grown as an annual. To keep the plants for a second season, cut them down within a few inches of the ground when they have apparently finished flowering, stir the soil lightly and give a top-dressing of manure and the plants will produce new shoots and flowers.

Snapdragons have been greatly improved of late and many new colours have been introduced. They can be had in three heights—the tallest class growing about 3 feet high, the intermediate about 1½ feet, and the dwarf about 9-10 inches.

Sow on the plains during September-October; on the hills from March to June. Also in early autumn. On the plains, where the rainfall is light and the weather cool, they can be sown also about the end of May or beginning of June, when they will flower from September onwards. They will keep on blooming month after month, if the faded flowers are constantly removed and no seed-pods allowed to mature on the plants. It is a good plan to pinch out the tops of plants when they are small—say when they are about six inches high—so that they do not flower very early and thus root-growth is encouraged. If flowering is thus deferred a little, the plants will throw out more side-shoots and flower better.

They may be grown either in beds or pots. Transplant the seedlings as soon as they are large enough to be easily handled, at a distance of 9 to 12 inches. In rich soils, the distance may be greater. The intermediate class is best for bedding out and also fairly good for cutting. The tall class furnishes better material for cut-flowers, as the spikes are longer. Being hardy and very easily grown, they grow and flower even in poor soils, but they do much better in rich soils and quickly respond to generous treatment. Frequent doses of liquid-manure or some quick-acting fertilizer, greatly help to bring them to perfection.

(For diseases of Antirrhinums, see page 86.)

ASTERS

Callistephus chinensis. [Family, *Compositæ*] is the botanical name of the original single-flowered Aster which came from China nearly two hundred years ago. Because the original plant came from China, the whole family of garden varieties comes under the general title of China Asters. Besides, as the German florists have developed the flower and produced a considerable number of races, it has also come to be known as German Aster.

Comparatively few people, however, are fully aware of the great extent to which this beautiful flower has been developed during recent years. The Chrysanthemum-like flowers are unsurpassed in beauty. They vary in colour from a delicate pink and white to deep reds and purples. They are especially adapted to house decoration, and when cut and placed in water, hold their regal heads erect for one to two weeks without withering. If a tea-spoonful of cane sugar is added to the water in which the cut flowers are

placed, it will do much to freshen them. No other plant occupying the same space provides more cut flowers as Asters. By planting Asters of the early-flowering type followed by a late variety, flowers can be had for quite a long time. The plants vary in height from 8 inches to 3 feet in different varieties, and in the matter of form, there is a wide and pleasing variation. Some of the types have incurving florets; some have broad and loose, elegant florets; some are imbricated; some quilled.

Asters can be easily grown in every part of India. They naturally succeed best in a rich, loamy soil and in cool weather. But with proper attention to the season of planting and careful cultivation, they can be grown quite successfully in any fair garden soil.

Among the secrets of success in raising Asters to perfection, we may mention that the plants should receive no check in their growth, from the seedling stage to bud development; also they should not be subject to violent changes in temperature and a very high temperature is at no time desirable.

Asters, though surface-rooting plants, are gross feeders; therefore, for best results, an abundance of food and moisture must be continuously furnished, a well-enriched loamy soil deeply worked, being essential to induce roots to go down for their supplies of food and moisture. When the roots are confined to the surface, the plants are liable to dry out or starve. A good covering mulch of rotten manure or hay in hot, dry weather is very beneficial, as it does not allow the soil to dry soon and provides some nutriment. Watering should be done whenever necessary. It should not be given in very small quantities but in doses large enough to thoroughly saturate the soil. Otherwise, if the soil is only superficially wetted, the roots are likely to be drawn towards the surface, which being usually hot in day time, greatly injure the plants.

The seeds should be sown thinly in shallow drills about three inches apart, just covered with fine soil (not over a quarter of an inch deep), either in a finely prepared seed-bed or in shallow boxes (2½ to 3 inches deep) or in earthen pots. They may also be sown broadcast, lightly covered with fine soil and pressed down firmly, so that the seeds may come in close contact with the soil. Water very carefully and gently, never letting the seedlings suffer for want of water. The best compost in which to sow the seeds and grow the seedlings, is made up of about equal parts of decayed leaf-mould and loamy soil, with a little addition of wood-ashes and some fine sand to facilitate drainage. In absence of leaf-mould, use well-rotted horse or cow manure. When the seedlings have attained the third leaf, they should be carefully transplanted about two inches apart, into other seed pans or shallow boxes containing fresh soil of a similar nature. This early transplanting checks the tendency to damp-off, and gives the individual plants sufficient room to develop a stocky growth. In two or three weeks' time, if the seedlings have been grown properly, they may be potted off singly in small pots or bedded out. When the plants are transplanted to the flower-beds or pots, firm or pack the soil solidly about the roots of the freshly set plants, allowing the soil to remain in this condition for about a week, and watering when necessary. After this, the soil should be frequently stirred as will be suggested below. In the early stages of their growth, they may be given partial shade, though it must not be forgotten that they need plenty of light and air at all times.

Keep the ground free from weeds and frequently stirred, but do not go deep enough to injure the surface roots. Thorough and frequent cultivation is very important and at no time should the surface be allowed to get hard or baked. This condition results in the soil quickly becoming dry, prevents the admission of air to the soil, thus checking the growth and weakening the vitality of the plants. When well in bud, a top-dressing of rotted stable manure should be given, which not only will nourish the plants but will keep the surface of the soil cool and moist. It is only when grown under such conditions that really fine flowers come up and the plants hold out. Fresh manure should never be used for Aster culture, as it may scorch the plants. Occasional applications of liquid manure (which must not be too strong) generally assist in producing magnificent flowers. Wood ashes or slaked lime incorporated with the soil will do much to prevent root and stem diseases to which Asters are liable.

To grow prize flowers, use the large flowering (mid-season and late) varieties, allowing the well-grown plants to carry but five or six main stems, each with its terminal flower; all other stems, side branches and buds should be removed to throw the full vigour of the plants into the few remaining flowers.

Asters, especially those of the dwarf, compact types are very decorative as pot plants; for this purpose, it is only necessary to lift the plants when they are just forming flower buds, disturbing the ball of earth as little as possible, and pot them. Water liberally, and shade for a few days from the sun, until root action has returned and the plants seem to be growing and well established. Then they may be brought out in the open.

For bedding, the usual distance is about 6 to 8 inches for the very dwarf sorts; 10 to 12 inches for those of medium height and 15 to 18 inches for the tall, late-growing varieties.

The Aster fares best during the cool rainy months, from June to October, in places where the rainfall is not heavy—not over 40-50 inches or so, and where the weather is usually not hot during these months. But where the rainfall is heavy, the best time to sow is soon after the rains—in September-October. In Madras and Southern India, the sowing time is also September-October. On the hills, sow from March to May and also in autumn.

Aster Wilt or Stem-rot—A specific parasitic fungus disease—*Fusarium wilt*—also known as Aster Wilt—is spreading in many of our gardens. This disease is generally carried in the soil and stays there for many years, making the soil "Aster sick". No remedy is yet discovered for this. But a resistant strain of Asters with extraordinary vitality and health has been recently developed which is able to produce healthy, strong plants. Resistant Asters, however, are vaccinated so they are resistant to the disease just as a person may be vaccinated against small pox. We recommend this strain to those who had difficulty in growing Asters. So remarkable is the success of this wilt-resistant type, that people who had first thought it impossible to grow the Aster, have now been again quite enthusiastic about it.

(For further notes on this disease, see page 86.)

To the amateur, who is not familiar with the above method of cultivation, it will sound very laborious, but in practice it will be found that if the stirring of the soil, transplanting and other operations are repeated frequently,

an ordinary sized bed or two, or a few dozen pots in an average garden, could be managed quite easily, and the reward will be certainly adequate to the trouble taken.

BALSAM

Impatiens balsamina. Family, *Gesneraceæ.*

The garden Balsam or Lady Slipper is an old favourite. They are rather formal plants of neat, compact habit. The flowers are produced close to the stem almost hidden among the leaves, and some gardeners remove a few leaves, the better to disclose the blooms. The plants may be grouped in the border or used as low hedges alongside the edge of large beds.

It is one of our very best and perhaps the most popular of our monsoon annuals. The plants make very quick growth and flower quickly and abundantly. As the flowers have very small stems, they are not suited for cutting. The blooms are of many beautiful colours and delicate shades—white, blush, pink, salmon, rose, crimson, purple, violet, etc.

It is very easily grown and should be found in every garden during the rains. Seeds may be sown at any time from the beginning of the rains onwards—say from June to August. On hill-stations, from April to June. In Madras and Southern India, the best time is from August to December. In upper India, it is also grown during the summer months.

Balsams quickly respond to extra care such as enriching the soil and a little liquid fertilizer. With good care, strong side-branches will be thrown up by the plants and there will be perfect wreaths of flowers. They must be given an open, sunny situation and should never be allowed to flag for want of water. Transplant when the second leaves have made a little growth. Set the plants about a foot apart. When the side branches appear, pinch off all but three or four and also pinch out the centre shoot. Those left will grow strong and the flowers will not be much concealed by the foliage, as will be the case if the plants are left unpruned. Some gardeners keep all the side-shoots pinched off, leaving only the main, upright shoot. This gives a good effect if the plants are well grown. When only the main stems are allowed to flower, the plants may stand closer together—say about 8 inches. Others leave the plants entirely untouched.

Recently quite a distinct type of the ordinary Balsam is developed which is very dwarf and bushy in habit, seldom growing over a foot high. Unlike the taller growing Balsams, the flowers in this new Bush-flowered type are carried at the tips of stems, forming pretty, rich bouquets, above the foliage. A distinct advance in this popular annual.

Transplanting the plants twice or thrice will produce dwarf plants and more double flowers. Balsams can also be grown in pots, if given proper attention.

Sometimes the choicest seeds will produce plants with mostly single flowers. This is usually due to two causes: "Forcing" weather and poor soil. When weather is continuously hot and moist, the plants do not make sufficient root-growth, and burst into bloom earlier than usual. Much cannot be done in such cases, but the removal of flowers as soon as they appear and an application of some fertilizer, generally improves the growth and the flowers that follow will be perfectly double.

BEGONIAS (Fibrous and Tuberous-rooted.)

Family, *Begoneaceæ.*

Begonias succeed best in a cool, partially shady situation, and need a light, loose, though fairly rich soil. The two classes named above are distinguished, the first by its numerous fibrous roots and small yet numerous flowers and its almost perpetual blooming quality; the second by its large tuber, which lies dormant like that of the Dahlia or the Gladiolus after it has finished its growing period, and by its very large and bright-coloured flowers.

When grown from seeds, very cold weather should not be chosen, as they need warmth and will not come up and grow satisfactorily if the weather is very cold or frosty. The seeds are very very minute and require great care and gentleness in growing. Any light, fairly rich garden soil, mixed with an equal quantity of well-rotted leaf mould, to which is added a small quantity of fine sand and charcoal dust, will make a good compost to start the seeds in. This should be sifted through a rather fine-meshed sieve and the surface made perfectly level before sowing. Sow the seeds in shallow pots or boxes. These may be watered carefully a few hours before sowing. The seeds may then be mixed thoroughly with a small quantity—say half a cupful—of the compost and sprinkled evenly on the surface of the soil, and gently yet firmly pressed down. When the surface soil begins to dry, the pot may be immersed in another pot or pan of water so that the soil may soak water from the bottom. Thus, overhead watering which is injurious to the fine seeds is avoided. Shelter the seed-pot from direct sun or heavy rain, and if the weather be sunny and bright, the pot may be covered with a piece of glass overlaid with a sheet of paper until the seed germinates. This will tend to conserve the moisture and prevent intense light from reaching the soil. The glass and paper should of course be removed as soon as the seedlings appear. See that the soil is kept constantly moist (but not too wet), and is never allowed to become dry. After a few days, a green, moss-like growth will be observed as the seed starts into growth. Care must be taken not to over-water the plants or they will rot—"a little and often" being the best rule in watering such tender and tiny seedlings.

The young seedlings are likely to come up too thickly—especially of the fibrous-rooted sort, as they have more vitality than the other—and will need transplanting as soon as they have formed two or three good-sized leaves. The seedlings may be transplanted in other pots or "flats" (see under "Pots, boxes and tins" in Part I), lifting them very carefully with a knife or a small, thin paddle of wood and putting them down at a distance of about 2 inches apart each way. When transplanting plants with fine, fibrous roots, it is well to lift a large ball of the soil with the plants, so that the roots may not be disturbed more than is absolutely necessary. Make holes to set them in, sufficiently large to receive them. Use similar soil as the first, and here let the plants grow, until they begin to crowd each other out. It may be found when transplanting, that some tiny plants stick together and are difficult to handle singly. In such cases, treat the clump as one plant and carefully put it in the new soil. Here they may grow for some time, and when large enough, may be again divided and treated like single plants. Give them a partially shady, though rather warm place. Once the plants reach a certain size, their growth is rapid, and they do not need such careful handling as before. At first, the plants may be put singly

in small pots, from which they should be transferred to larger pots as they increase in size. The treatment of both the types of Begonias is similar in the earlier stages of their growth; but the fibrous-rooted type will grow more quickly than the tuberous-rooted.

The Begonia is a shallow-rooted plant, the roots remaining near the surface. When stirring the soil, care should therefore be taken not to work too close to the plants, nor too deep; otherwise the smaller tender roots are likely to be injured. A light mulch of straw or manure is very beneficial.

The Fibrous-rooted Begonias begin to bloom when quite young, and are perpetual bloomers—that is, they will bloom throughout the year if given plenty of moisture and enough room, together with a rich soil for the roots. They may be used as pot plants in the summer months in a conservatory, or if desired, they may be planted out in flower-beds in mild winter weather, or during the rainy season where rainfall is not very heavy and the weather more or less equable and not very hot. They will bloom more freely and produce larger flowers if the blooms are cut off as soon as they fade and are kept from producing seed, which rapidly exhausts the strength of the plants. After the plants have flowered for some months and when they begin to show signs of age, they may be transferred to larger pots, using a rich compost. The tops of the plants should be cut down nearly to the base. The roots will then throw out fresh, strong shoots, and will again make fine blooming plants in a short time. They are also propagated easily by means of cuttings during the rainy season.

The Tuberous-rooted Begonias are distinct in growth and flower, the plant being more open in growth, and the leaves and flowers larger. Besides, they are more brilliantly coloured than the preceding type, and possess a greater diversity of colouring. In general, they are most satisfactory as specimen pot-plants in a partially shaded porch or a cool plant-house, or as hanging-basket plants. Otherwise, if planted in beds, they must be given a partially shaded location for the best results.

Unlike the fibrous-rooted sorts, they do not bloom early. These plants, however, must attain a certain size before they flower. The large flowers are sometimes too heavy for the stems and need light stakes to support them. Drainage should be perfect, and no water allowed to stagnate near the roots. When planted in beds, they may be put down about 15 inches apart each way. After they have finished flowering, the plants generally begin to dry up, and in order to preserve the bulbs for the next season, water should be discontinued gradually, and when the leaves and stems have nearly all died down, the plants may be dug up and after removing the dead stems, the roots carefully stored in a cool, dry place, either in sand or dry soil. Long exposure to rain, when the plants are growing, is very injurious, and sometimes kills the plants.

The Tuberous-rooted Begonias are grown much more easily and in less time, by putting down bulbs purchased from seedsmen or nurserymen They are not very costly, and are stocked in different colours.

On the plains of Central and Southern India, sow the seeds about the beginning of the rains. In the North, during September-October. On the hills, from March to May. Bulbs are usually available for planting, from February to August-September.

(For diseases of Begonias, see page 88.)

CANNA

Canna indica. Family, *Scitamineæ.*

The Original Canna

Canna indica or **Indian Shot** is native to India, and grows abundantly and luxuriantly almost everywhere. The original plant grows about 5 to 6 feet high in its native wilds and produces small and insignificant flowers of scarlet and yellow. It is not usually given a place in flower-gardens, except by those who prize it for its foliage and the tropical effect it gives to the garden.

The Modern Canna

In the hands of the hybridizers, this plant has undergone a marvellous evolution, emerging from the centuries of its obscure life into a revelation of beauty and grandeur equalled by very few plants. As a bedding plant it holds front rank and is often described as their "king" in the catalogues of European and American nurserymen. In Europe—especially in France and Italy—and in America it has become a general favourite and is very extensively employed as a summer bedding plant. Those who have not seen the latest varieties in bloom can hardly conceive of their beauty, so much have they been improved during recent years.

Classification

Some horticulturists divide the modern varieties into two classes according to the habit of the flowers—the Orchid-flowering and the Truss-flowering. The first is very large flowering and usually taller than the other varieties. But in this class, the flowers do not all open together, which is sometimes a disadvantage. In the second class, the flowers mostly open together and form larger heads. They are therefore often preferred. Most of the newer creations belong to this class and large beds of one solid colour make a very impressive display. Other horticulturists classify Cannas according to the colour of the foliage—green or bronze.

Cultivation

The cultivation of the Canna is very simple. As it is a gross feeder, no soil can be made too rich for it. Select an open situation, dig the soil at least two feet deep and enrich it well with any well-rotted manure. If the soil is sandy and light, it is a suitable one. But if heavy or clayey, it must be made light by a liberal quantity of leaf mould, sand, or horse manure containing lots of straw—all well decayed. Plant the roots rather deep, covering them well, and water rather sparingly for the first few weeks. It is always a good plan to cover the roots with some fine sand on all sides, as otherwise some of them are likely to rot and die. Later on, water freely and copiously. They make a good show if planted in round beds or long borders. They can also be very effectively grown in large pots, preferably in wooden tubs. They grow rapidly, and flower quickly and for many weeks. The flower-spikes, after they fade, should be cut down at the bottom near the ground, when new shoots will quickly come up to take their place. Frequent doses of liquid manure while the plants are growing, will be found beneficial.

Transplanting

They can be transplanted at almost any time of the year, but the best time is about two or three weeks before the rains commence, and then again after the rains are over. They could thus be made to flower first during the rains, and again during the cold weather. By judiciously timing the transplanting operation, flowers can be had throughout the year, and they have been known to flower even during the summer.

They multiply very quickly; it is therefore advisable never to allow them to crowd themselves out, as then the flowers begin to deteriorate. It is best to change the site every other year and to lift and transplant the root-stock every six months or so, discarding the old roots and transplanting newly formed roots with buds. Before transplanting, it is an excellent plan to withhold water for about ten or twelve days, then to dig up the plants carefully and heel them together in an upright position in a cool, shady place. The beds may then be dug up about two feet deep, replenished with fresh loamy soil (if the original soil is not very rich) and well-rotted manure, and after this, the rested roots may be planted in the usual manner.

Round Canna Beds

When one variety is planted in a round bed by itself, the effect is excellent. The usual distance at which to plant Cannas is 18 inches apart each way. Plant 1 Canna in the centre, 6 in the first circle, 12 in the second circle, then 18, 24, etc., according to the size of the bed, with the circles 18 inches apart. A bed 4 feet in diameter takes 7 Cannas; a 7-foot bed, 19 Cannas; a 10-foot bed, 37 Cannas; a 16-foot bed, 91 Cannas.

Some of the recent varieties are very shy seeders while others seed freely. The former usually maintain their height and do not deteriorate even when grown year after year. The latter are likely to grow taller, and to deteriorate quickly—especially if neglected for some time.

On the Hill stations of Northern India, the best time for planting bulbs is perhaps March-April. Being tropical plants they cannot stand frost, and so, on its approach, they should be lifted like the Dahlia and stored in a rather warm, dry place, covered up with dry sand or soil. Replanting should be done on the approach of warm weather the next spring.

Propagation

Their propagation is usually effected by division of the roots (or rhizomes, as they are more properly called). This is the commonest method. New varieties can be raised from selected seeds, which are round, black, and very hard, of the size of small peas. The name Indian Shot is due to the resemblance of these seeds to lead shot. Seeds ordinarily take a month or more to germinate and owing to their hard shells come up very irregularly. If the outer covering is filed by an ordinary file in one place or opened up by a sharp penknife, so that moisture can reach the germ, they germinate very quickly and easily. Keeping them in hot water or in cow-dung paste for 2 to 3 days before sowing, is also a good method to hasten germination. All plants raised from seeds will not produce large and good flowers, as they have a tendency to "revert" or go back to the original type. Those which are not good may be discarded, and the good ones taken care of.

There are about 500 or more named varieties on the market, but many of them are only duplicates. Several new varieties make their appearance every year and sustain the interest in this plant from year to year. The recently introduced varieties are indeed very fine from every point of view, and Canna lovers would do well to grow at least a few of them, side by side with old, established varieties.

In the April 1938 issue of "The Gardener", an article on this flower has appeared by Mr. R. K. D. Kapur, M. Sc., L. T., Rajkumar College, Raipur. It contains so much useful and practical information that we have thought it advisable to give below extracts from his article. The magazine was formerly published by Pestonjee P. Pocha & Sons, P. B. No. 55, Poona.

"I am opposed to giving cannas a start with heavy manure. My experience tells me that they outgrow their size during the rainy season here, if the beds are initially heavily manured, and the stem growth is encouraged at the cost of the flowers. Moreover, I do not like tall cannas and I think their beauty lies in heavy healthy heads on short strong stems. Three feet I should regard as an ideal height for flower-heads above the ground.

"Some cannas have a longish habit and you can use them to give a pyramidal shape to some of your circular beds, planting this variety in the centre surrounded by dwarfish ones.

"So if your place has a heavy rainfall you should not manure your beds heavily in the beginning, just a little manure would do; four weeks after the bulbs have been put in, you should give them the full dose of manure. I have been applying 2″–3″ thick layer of well rotted horse-dung for my canna beds, or roughly a cart-load to a bed 20′ × 6′. Like all other manures this should be well mixed in the soil. If, however, the rainfall is not above 40″, the full dose of manure should be incorporated with the soil in the beginning, i. e., before the bulbs have been put in.

"This manure will be sufficient for them till September-October when another top dressing will be needed. Still another will be needed in January. This last will keep them strong, well-fed and happy looking till the middle or end of March.

Putting in the bulbs

"The bulbs should be put in a week or so before the rains break. They should be placed at least 6″ deep in pairs surrounded by a little sand and at a distance of 25″–30″ from pair to pair, thus affording them plenty of space to develop their root-system and multiply themselves. I personally do not like placing single bulbs only 18″ apart from one another. After the bulbs have been put in, the bed should be watered just enough to moisten the soil round about the bulbs. Heavy watering at this stage causes rotting of the bulbs. It is to avoid this rotting that sand is put around the bulbs when placing them in beds.

Watering the beds

"The rains now set in and soon in July the roots will be well established and they can stand plenty of watering. Cannas prefer actual flooding with water by means of a hose now, watering with a can taking time and not meeting their needs. During the rains, however, you might not feel the necessity of watering the cannas more than once a fortnight. Even that may not be necessary. But after September, or as soon as the rains are nearly over, flooding the beds

once a week would be very desirable. The soil must be kept loose and cultivated after watering. This should be done a day or a couple of days after watering according as the days are warm or cool. The upper layer of soil broken fine will stop wastage of water by over-evaporation and will help to retain moisture.

"The flower heads start appearing after the sixth week from the time the bulbs are put in. But the first stem that bears the flower-head should be cut back, this will cause the root system to strengthen and healthy new shoots will appear. These will grow quicker and from one root system a number of flower heads will result.

When do the flower-heads appear?

"When cultivating the soil at this stage care should be taken that the new shoots are not broken or cut.

"The beds thus will be filled with flowers more compactly than they would otherwise do. All your cannas should be in full blossom in the month of September.

"As soon as a canna head has done flowering, it should be snapped by a downward jerk (try it for yourself, you will see that the stem breaks clean at the base without disturbing the roots), or by cutting it with a knife. This should be done as frequently as possible, though it seems rather cruel; during the rains the heads do not fade off soon, but that does not matter, they must be removed if you desire your canna beds to look continually full of bloom in the months to follow. They will be at their best throughout October, November and December if this is attended to carefully. If not, because you or your mali think that the head is "so good yet", be sure you will have practically no blooming after some time, for all the stems bearing flowers will have to be cut down in a very short time, leaving the beds miserably thin, probably as thin as they were in the month of July. Usually the sign of a "done-up" stem is the appearance of seed pods on it. If such stems are allowed to stay on they will, besides retarding the growth of new shoots, rob plenty of nourishment from the soil.

Mali's job in canna beds every morning

"Some people recommend thinning out cannas in the month of October. They suggest breaking up of root clumps and replanting them as you did in the end of June. This has just one big disadvantage. You will miss flowers for some time. My experience is that if the stem breaking has been thoroughly attended to, the replanting will not be necessary. Moreover, the manuring of beds in October and January, as recommended above, will keep your beds going till March. Again, the spacing of 25″–30″ between bulbs would enable them not to get over-crowded.

"If you have very hot months, you should with advantage do as I do. In the month of March when the flowers are still on, I take out all the clumps from their beds and place them side by side in deep furrows made in a couple of shady beds, prepared for this purpose, thus transplanting them thickly; though each kind is separated from the other by labels. When all the clumps have been transferred to these shady beds, their roots are covered by soil and their stems are all cut down so that they

Stocking Canna bulbs for the next term during the hot months

just peep out of the soil. The bulbs remain here in shade through all the hot months getting regular supplies of water. Plenty of water, however, is saved by this method for if we leave our bulbs out in their respective beds we will have to supply them with a tremendous quantity of water which we could not possibly do at that time. The bulbs, densely packed as they are in these shady beds, do not multiply very fast, but they will yield enough new bulbs to you and to spare. In June you will take them out, throw away the old ones and use the new ones for your beds."

CARNATION

Family, *Caryophyllaceæ.*

In Europe and in many parts of America, where great attention is paid to its cultivation and development, and where it grows to perfection, this beautiful and favourite plant is supposed by many to be a rival of the Rose, hundreds of lovely named varieties are grown, magazines are devoted to its culture, and societies are formed by flower-lovers to further its progress.

The Carnation is generally divided into two classes: the Perpetual or Early-flowering, and the Hardy or Border Carnations. The former is treated more or less like an annual, coming into bloom within four months of sowing the seed, and flo wering continually for months. The latter usually flowers the second year from seeds, and is hardy in cold countries, requiring only a little protection in winter and blooms for some years. It is the former class which, however, is more adapted to the warmer parts of our country, and can be grown anywhere in India, with a very fair degree of success. On hill stations and in North India, very little difficulty is experienced in growing both the types.

The Carnation belongs to the same family of plants as the Dianthus and Sweet William. On the plains of India, the best time to sow the seeds is about the end of the rainy season. In places with a moderate rainfall, they could be grown even during the rains, especially if protected from occasional heavy showers and from long spells of wet weather. The early strains will flower all through the cold weather, and even during part of the hot weather in places where the summer heat is not great, especially if the plants are removed into the shade of trees. On the hills, the early strains may be put down as soon as the weather has become mild in March or April, and the other old-fashioned Border Carnations may be put down from June to August, the earlier the better.

The Carnation thrives best in a compost made up of turfy-loam, enriched with leaf-mould and well-rotted cow or horse manure, with a little addition of sand and charcoal dust. Sow the seeds in well-prepared seed-beds or pots, rather thinly, covering them with about a quarter of an inch of fine soil, and when the plants have come up and are about two inches high, transplant them singly in small pots; shift them to larger pots as they grow bigger. To ensure good flowers, the blooming stems should be carefully tied to sticks inserted near the plants and the buds thinned down to only one or two flowers on each stem, the general rule being to allow only the top and third bud to remain and to remove the second (which is usually too near the top bud), and other buds. Frequent doses of weak liquid manure

are very helpful. The plants may also be bedded out in favourable weather and will make a very good display in the garden for months. The early flowering class of Carnations has also the advantage of a strong clove scent and its introduction has given a great impetus to the cultivation of this hitherto difficult plant. We have been able to make these plants bloom throughout the year, even during the summer months, in the climate of Poona.

It has been found that the use of a 0.1 solution of boric acid (one in ten parts) will improve the keeping quality of cut Carnation flowers by three to seven days.

When grown from seeds, a certain small percentage of plants produce single flowers; these plants may be destroyed. Some choice varieties may be propagated by cuttings or layerings, during the rainy season.

(*For diseases of Carnations, see page 88.*)

CHRYSANTHEMUM

Family, *Compositæ.*

[*The following hints on the popular Japanese Chrysanthemums by Mr. B. S. Bhatcharji, F.R.H.S., are reprinted from "The Gardener",* April 1937.*]

During autumn when the Chrysanthemums start to bloom making the garden ablaze with colour, flower lovers appreciate the epithet "Autumn Queen" generally given to the Chrysanthemum.

The successful culture of Chrysanthemums, however, is not found to be so very easy, although it is really very easy, when the correct methods are properly understood. The weather occasionally stands seriously in the way but a cautious grower can manage with this trouble to a great extent.

Generally, people start growing suckers from February and the young ones, with all the care bestowed on them, grow into strong plants before July. This system is good in places with about 30 inches of annual rainfall. In places with greater rainfall the plants that are sufficiently grown up and are above 1 ft. in July soon exhaust themselves and turn to leggy plants by October when they start producing buds. This is particularly the case in places with about 50 inches of rainfall. The more sappy and leafy the growth is during October, the better will be the flower. Growth of the Chrysanthemums is almost like that of annuals which start exhausting them after a limited period of growth. If you get your bud when the zenith of growth is over, the flower gets much less nourishment. In places with low rainfall the dearth in atmospheric humidity regulates their growth which you are to help with sufficient leaf-mould, very old cow-dung and proper watering.

A plump healthy plant is a necessity for a good flower but it should be on the dwarfer side before the starting of the rains. It requires proper nursing and cautious feeding. Amateurs may better leave these to the nurserymen even if they have to pay a higher price for the plants during June-July. A leggy plant that has formed hard wood and has shed much

* Formerly published by Pestonjee P. Pocha & Sons, Seed Merchants, Poona.

of the lower leaves can never produce the best exhibition blooms. The best course left is to force the plant, by pinching the top, to branch freely and have a decorative effect by compensating size or shape with number of blooms.

Young plants should not have any forcing with manure before July. Watering that is sufficient to keep them alive and a little leaf-mould to prevent the soil from running dry too soon, if the case be so, will be just enough to keep them right until July. During July they should be planted in good loamy soil (a soil that is not sticky) mixed with equal quantity of a mixture of leaf-mould, cow-dung at least one year old, and old mortar rubbish in a crushed state. To this compost add a table-spoonful of bone dust per plant. If old mortar cannot be had you can use the following with advantage. Weeds and other garden refuse should be heaped when dry and covered with garden soil. This should be set fire to and burnt like a brick kiln but not allowed to run into flames. This burnt heap should be broken fine and used in the compost.

Chrysanthemums suffer most from stagnant moisture and unless the compost is porous enough they do not thrive. When they are grown in beds a situation slightly raised above the surface is a necessity for healthy growth. Beds raised on all sides and sloped like tortoise shells are ideal for growing them in the ground. One cubic-foot pits dug in such beds and filled up with the above compost will grow them much better than in pots.

After the plants are either finally potted with the compost as stated above or planted out in beds with the same compost, they will, within a short time, start growing vigorously. As soon as you find that they are growing fast, pinch the growing top with only one or two leaves. Thus they will be forced to branch. The finest plants are those that are so grown as to branch from as low as possible. Striking of cuttings or planting suckers should, therefore, be continued up to early July, so that dwarf plants are available. Some of the earlier plants will grow tall enough to require a pinching much earlier in order to stop them from growing too leggy and tall. Dwarf plants planted in July will be fit for pinching some time in August. When the largest exhibition blooms are required, only two branches should be allowed to grow and the rest pinched off. If the plant is weak, only one stem should be allowed to grow. In places with heavy rainfall planting should be made finally by the end of July in the beds and a fortnight earlier in pots. Those planted earlier may require pinching more than once in places with heavy rainfall as the growth may be too fast. The largest specimen blooms grow from plants producing only one stem and not allowed to branch. Such plants should naturally be planted a little later in the season so that they produce buds during the zenith of their growth and before getting leggy. Suckers or cuttings produced later in the season will be the best for this purpose. In places with about 50 inches of annual rainfall plants that are quite healthy and plump but not more than about 6 inches high in July will be fit for producing specimen blooms. There is some risk in producing only one flower per plant by allowing them to grow without being pinched. Many of such plants may have either their stem tops flattened through excessive growth or may form too many leaves as if in clusters, on the tops at the cost of buds. It requires keen observation and experience to detect such unsuitable growth which should be forced to branch by pinching as soon as detected.

Decorative varieties of Chrysanthemums produce flowers smaller than the exhibition types. They are much easier to manage and would quite compensate the deficiency in size by their number. They should be pinched twice or thrice according to growth and allowed to branch freely. About a dozen or more blooms per plant can be had by inducing so many stems per plant. All side shoots and buds, except the central ones, should be pinched off as in the case of exhibition varieties.

The Cascade varieties, comparatively recent ones, are highly decorative with dozens of their small flowers. They should never be disbudded nor need their side shoots be touched. They should be forced to maintain a persistent growth from July. In places with scanty rainfall they should be started in their final shift from June. The main stem of this type of Chrysanthemum grows long and hangs down with the weight of side-shoots crowned with sprays of flowers in cascade fashion. When well grown they are most attractive in pots and require stands to be placed on.

When the plants grow into very healthy specimens in their final quarters, all suckers from the roots and side shoots from branches should be cut off so that the plants' energy may be applied entirely towards the buds that are expected. When the cluster of buds appear at the top of branches, only the central one should be retained and the rest from each branch should be disbudded as soon as you can handle them. Feeding with liquid manure should be started once a week as soon as buds appear. Raw cow-dung left in water for about a week and strained through a sieve will be the liquid manure and should be applied to the colour of weak tea. Watering should be carefully done at all times. The roots of Chrysanthemums do not go down very much and the surface roots are the most useful to them. When the rains are over or when there is a dry spell even during the rains, they suffer badly for want of water. Pot plants will, at times, require watering twice a day when the soil runs dry very soon. Light watering whenever the soil is dry is the best for them. At times the surface soil may be too tight to allow water inside. The soil should then be cultivated. When the buds grow, liquid manure should be increased to twice a week. When they open out the plants should have plain water only and no manure.

There is such a large number of varieties and many of them are so similar that it is best to leave the selection to specialists instead of insisting on some kinds after seeing flowers specially grown for exhibition. Easier varieties are the best to start with and are entirely satisfactory even if they do not produce a few show blooms that are difficult to produce unless you are fully accustomed to the growth and nature of Chrysanthemums, which is possible more through experience than through reading about them.

Annual and other Chrysanthemums: The annual Chrysanthemums are quite different from the above, and like other annuals are very easily grown from seeds. In places with light rainfall where the weather is generally cool during these months, the seeds could be sown during the monsoon, but they do best if sown soon after the rains are over, in which case they bloom during the winter. The single flowers are very pretty, resembling coloured Marguerites, and deserve to be grown more.

Chrysanthemum coronarium from the Levant, *C. carinatum* called also *C. tricolour*, from Barbary, and *C. segatum*, single Star Chrysanthemums, and their many varieties, are very ornamental border annuals.

Chrysanthemum (Leucanthemum) grandiflorum, the common Ox-eye Daisy and *C. maximum*, the common Marguerite or Shasta Daisy, and *C. frutescens* the Paris Daisy of the florists, are beautiful plants of a shrubby and perennial habit and thrive well in the north and on hill stations, producing for months, large, very pretty, pure white flowers which are largely used for floral decorations.

(For diseases of Chrysanthemums, see page 89.)

COSMOS (MEXICAN ASTER)

(Cosmea bipinnatus)

Family, *Compositæ.*

One of our most easily grown annuals. Tall-growing plants with elegant, feathery foliage, and white, pink, rose, crimson and purple flowers.

Being very hardy, it stands heavy rains and heat and can be successfully grown at almost any time of the year, except the winter in Northern India. The best time to grow is during the rains. Sow at the commencement of the rains and transplant at a distance of 18 to 24 inches. In ordinary soils it will grow to a height of 3-4 feet but in rich soil it will grow about 6 feet high. During the winter and summer, the growth is not so luxuriant and the plants should be put down closer together. It can also be sown at the end of the cold weather, when it will flower during the summer. On the hills, sow from May to July. In Southern India, on the plains, the best time is September-October.

Sometimes owing to "forcing" weather or unsuitable soil, the plants may begin to bloom very early while yet quite small. Remove all flowers and buds. Stir the surface gently and give a top-dressing of manure. This will stimulate the plants which will then flower quite satisfactorily. The plants will need bamboo-stakes or some kind of support, as they are likely to be blown down by strong winds.

Usually, the Cosmos is not as impatient about coming into bloom as most annuals, but waits until it has made its growth before expending its energy in flower production. The early-flowering class is useful on Hill stations, as it blooms in the summer before the Autumn frosts occur. The Double or Crested Cosmos is a recent development of this popular annual; instead of the yellow centre which shows in the single varieties, these have a double or crested, raised centre. Some flowers may be perfectly double. This new type is not yet quite fixed and some plants produce single flowers.

(For diseases of Cosmos, see page 89.)

DAHLIA

Family, *Compositæ.*

The *Dahlia variabilis* of the celebrated botanist Linnæus is a tender, tuberous-rooted perennial, and is one of the most beautiful of our flowering plants, useful alike for cut flowers as for giving colour and richness to the garden. It is one of the latest to be brought under man's influence and

developed into cultivated forms of unparalleled beauty and variety. Few plants have yielded so much to the skill of the florist. Nor have the limits to the Dahlia's capacity for variation in form and in colour been reached. Any careful garden-lover may confidently expect to produce further changes.

Its History

The history of its introduction into Europe is very obscure. Baron Humboldt, a Prussian naturalist and explorer, is generally believed to have first discovered it in Mexico in 1789. He sent it to Professor Cavanilles of the Botanical Garden at Madrid. It was the latter who named the plant **Dahlia,** in honour of Professor Andreas Dahl, a Swedish botanist and a pupil of Linnæus. This name is, however, not recognised by all botanical nomenclaturists; for many years the genus bore the name "Georgina" on the Continent of Europe, and this appellation is still adhered to in Germany by many leading horticulturists.

In England

While at Madrid and soon after it was received from Mexico, it attracted the attention of the Marchioness of Bute, wife of the British ambassador to the Spanish Court. The plant was introduced into England by her the same year, but as its treatment was not understood, it did not thrive till four years later, Fraser, a London nurseryman, gave it a thorough trial. He cultivated the crimson species *Dahlia coccinea*, and was successful in getting the plants to flower. Then again in 1804, Lady Holland brought over some seeds from Spain and at Holland House, Kensington, from the time their proper treatment was known, the art of the gardener supplemented the work of Nature, and the Dahlia began to unfold its great possibilities.

On the Continent

The Dahlia also received great attention in France, Spain and Germany, and it is still prized there as one of the finest of summer and autumn flowering plants. In the South of France where the conditions are even more genial, it soon became very popular, and within a year or two of its establishment in the gardens of the Riviera, the plant had well upheld its specific name of *variabilis*; the catalogues issued at the time give long lists of named varieties differing widely in colour. The prevailing shades seem to have been red, orange and yellow.

Although other species were discovered in and introduced from Mexico, it is remarkable that they should not have hybridized the varieties established in Europe and the *Dahlia coccinea*, Cav., continued to remain the favourite. Gradually, however, both the *Dahlia variabilis* and the *D. coccinea* broke into numerous colours and became general favourites. Botanists and gardeners have since produced varieties too numerous to mention.

In India

The history of the introduction of the Dahlia into India is very obscure. Reference to several writers has failed to yield any reliable information. There is reason to believe, however, that it was introduced into India from England about seventy-five years ago.

The original plant bore single flowers with eight ray petals, narrow, sharply acuminate and notched at the end, and with wide spaces between the tips of the rays, giving the flowers a star-like appearance.

The first Double Dahlia

The tendency to produce double flowers appeared soon after the Dahlia became domesticated in European gardens, but it was not until a quarter of a century later that a pronounced departure towards the double form was attained, the first double Dahlia having appeared in 1814. In another 50 years the Dahlia was in the front rank of garden plants. To-day it is still growing more in popularity as its capabilities are being developed.

When the Dahlia was introduced into British gardens, public taste was inclined largely towards primness and formality. The perfectly double, ball-shaped Dahlia was therefore not long before it became the flower of the day, usurping in public estimation the place of the Auricula and the Tulip.

Earlier types

The original double form was called the "SHOW"—a formal, round, stiff, double flower. Next came the "FANCY" type, a section of the foregoing variety with variegated flowers. The "POMPON" type is the same as these in form and colouring but much smaller in plant and flower and yields flowers more abundantly. It was originally developed in Germany early in the last century and was introduced in English gardens as late as about a quarter century ago.

The reaction against formalism in horticulture, which first manifested itself a little more than half a century ago, affected the Dahlia also and for some years it suffered comparative neglect, only to come forward later and achieve an increased popularity. This new interest in the Dahlia was awakened by the introduction of the "CACTUS" type, a development of the *Dahlia Juarezii* introduced from Mexico. A brilliant scarlet in colour, in form it was a composite of the "Cactus" and "Decorative" types of to-day, with foliage more finely cut than the older type—a plant of more slender and taller habit. "Cactus" is hardly the best name for the beautiful flowers of this variety, as there is, besides their spiky petals—little in them to suggest that formidable thorny growth so common in this country. The informal outlines of this type, its wonderful range of colouring, in self colours as well as richly varied blendings of two or more shades, gave a tremendous impetus to Dahlia culture and awakened an interest, which is world-wide and of growing influence. The first Cactus Dahlia *(Dahlia Juarezii)* is said to have been grown at Utrecht about 50 years ago, from seeds from Mexico. Accordingly it bears the name of its then President, Don Juarez.

The plant became a favourite, Dahlia Societies sprang up, and the autumn Dahlia fêtes became the chief events of the gardening year. The Dahlia came to Europe in times of stress and change.

Symbolic of Instability

It changed with the change of fortunes in Europe—the French Revolution, the Napoleonic wars, etc., contributed as it were to its fame for instability. Even from a botanist's or florist's point of view, this may be accepted, as there is no plant more unstable in our gardens. But we have no reason to lament this fact but rather to welcome the tendency to variation, as this gives us something new every season.

The Dahlia belongs to the *Compositæ* family, which have flower-heads which consist of many florets or a composite of flowers; thus the essential

organs which produce seeds are somewhat difficult to reach and do not readily set seeds. Their inability to produce seeds is supposed to be due to what is known as self incompatibility or self-unfruitfulness. Thus the same variety is not able to fertilize itself. There may be some exceptions but this seems to be the general rule in the highly developed modern types of Dahlias. Thus if a certain variety has to produce seeds, it must be fertilized by a different variety. This factor seems to be the chief cause of the instability of the Dahlia. Seeds collected from perfectly well-formed double flowers will produce quite a number of semi-double and single blooms.

Cultivation

Dahlia cultivation is very simple. It thrives in almost any soil, but where a choice can be made it is best to select a rather light, well drained and moderately rich soil. Heavy soil, with a clay sub-soil, should be avoided. Such a soil can be improved by adding to it very liberally, coarse coal ashes and sand, and mixing these into the soil to a depth of about 12 to 18 inches. For the best development of the Dahlia, a moderate rainfall which is well distributed during its growing and flowering period, and a mild, moderately cool climate with moisture in the atmosphere, seem to be necessary.

Location

For the successful cultivation of Dahlias, an open, sunny situation away from large trees such as would shade them or rob the soil of its fertility and moisture, is necessary. Dahlias do flower under partial shade, but the best results are obtained in a sunny situation. Care should be taken to protect them from heavy winds, as their tops are generally heavy and brittle, and have a tendency to snap off if not protected by a wind-break or held up by heavy stakes, to which they should be firmly tied. It may also be added that Dahlias are particularly adapted for seashore cultivation, because of the moisture and heavy dews which collect in such places during the nights. They need moisture at the roots, but it should not be excessive, otherwise the roots are likely to decay. For this reason they should not be planted in low places unless well drained, as continuous rain of a few days' duration is likely to kill them.

Watering

When large, healthy bulbs are planted in a good soil, which retains water for a considerable time, watering is not required frequently and should only be done when the plants show signs of wilting. They must, however, be watered copiously so that it penetrates to a depth of at least about a foot. It is a very good plan to stir the soil to a depth of one to two inches the day after watering, and carefully pulverizing it later, to preserve the natural moisture in the soil and prevent rapid evaporation. In some localities and soils, it may be found necessary to water almost daily, as the Dahlia is very susceptible to droughts, *and should not be allowed to flag for want of water at any time during its growth.* Constant stirring of the surface soil and keeping it free from weeds is also very important and is one of the chief factors of success.

Manures

While Dahlias will adapt themselves to almost any soil, it may be well to state that a good sandy loam is especially adapted to their culture, owing to its drought-resisting qualities. As the Dahlia is a strong, robust grower, it is not particular about the form of manure or fertilizer it gets, provided the necessary elements required for its development are there. Any well-rotted manure will give good results, if a sufficient quantity is well-worked into the soil. Barn-yard

manure, horse or sheep manure are all suitable. The manure should be spread on the surface about three inches in depth, and spaded into the soil. Should it become necessary to use an artificial fertilizer to stimulate growth, or with a view to get extra-large flowers, it should on no account be used during the early stages of the plants' growth. The best time to do this will be when they are coming into bloom.

Frequent doses of liquid manure are also beneficial when the plants begin to bloom. A small handful of pure Bone Meal and Nitrate of Soda, in the proportion of four to one; or a mixture of Ammonia, Superphosphate and Potash mixed in about the proportions of 4-10-6 is found to stimulate the plants greatly. Do not allow it to come in direct contact with the plants, but sow it in the ground and rake it in. Watering will dissolve it and wash it in.

It sometimes happens, however, that the soil is virgin and very rich. In such soils, manure is not necessary. In soil which is too rich, the plants will abound in leaves and will not produce satisfactory flowers.

The following very valuable and practical information on fertilizing has been taken from the book of a famous American Dahlia grower and will be found of great help to the ambitious grower who wants to grow this plant to perfection.

Fertilizer to be applied before planting. Scatter broadcast after spading and mix thoroughly into the top-soil to every 100 square feet of ground or to each 10 Dahlia hills.

5 lbs. raw bone meal.

{ 10 lbs. Unleached wood ashes, or
{ 1 lb. Muriate or sulphate of potash, not both.

An additional 5 lbs. bone meal may be spaded in with or before the above application if ground is very poor.

Fertilizer or top dressing to be applied a little before the plants come into bloom. Scatter broadcast over ground, not closer than 6 inches nor more than 18 inches from the stalk and rake in, to every 10 hills.

{ 1½ lbs. Raw bone flour, or
{ 3 lbs. Raw or steamed bone meal, not both.

{ 1½ lbs. Animal tankage, or
{ 4 lbs. Sheep manure, not both.

{ 5 lbs. Unleached wood ashes, or
{ ½ lb. Muriate or sulphate of potash, not both.

Manuring is not necessary, even in light soil, if the above formula is used, but an application of horse or cow manure or compost in the Fall (autumn) is very good for soils lacking humus. This can be used as a top dressing for a cover crop, or dug in by shallow spading in the Fall to help decomposition, then spaded in deep about two weeks before planting.

Propagation

Dahlias are grown either from seeds or by division of the roots. It is very interesting to grow them from seeds, as many new varieties are likely to be thus obtained. The seeds are best sown in a mixture of fine, light soil and well decayed cow or horse manure in equal proportions. As they are susceptible to moisture, it is a good plan first to level the surface of the soil, soak it

with water and to sow the seeds either broad-cast or in drills, distributing them so that they are not less than about half an inch from each other. Then cover them with a layer of about half an inch of fine sand. Water sparingly at first. It must not be forgotten that on account of their inherent qualities, Dahlias do not come true from seeds and show great variation in results.

The ease with which a large number of plants can be quickly raised at a small expense, and the fact that they bloom from seeds within four months' time, commends this method to many. Those, however, who desire to grow only a limited number of the best varieties, should grow them from roots. All our modern named varieties are grown from division of the roots. As the "eyes" (or buds) are not on the individual tubers, but on the crown to which the tubers are attached, care must be taken that each division has at least one eye. When the roots have grown for a season or two, they greatly increase in size and can be easily divided into two, three or more divisions. This is usually done at planting time as then the tubers begin to show the "eyes" and can be easily divided, and planted soon after.

Classification

The classification of the Dahlia is not very exact and due to the large number of forms and diversities in shape, it may be rather confusing to the amateur. There are many varieties which different florists would class under different heads. As already mentioned in the history of this plant, the Dahlia as it grew in its natural home was a single flower.

The development of the *Double, Pompon, Fancy* and *Cactus* types has also been described. *Double Tom Thumb* and *Single Tom Thumb* or *Pigmy* Dahlias grow only to a height of from 12 to 18 inches and produce numerous medium-sized flowers. They are suitable alike for bedding and pot culture. *Decorative or Modern* Dahlias are mid-way between the Cactus and the Double. The form is double, mostly flat, but of good depth; petals rather irregular, long, broad, flat and nearly straight. The name is well chosen, as the plants are truly decorative, bearing well above their foliage, their large, handsome flowers, in great profusion and in innumerable shades of very beautiful colours. The *Collarette* Dahlia is a single flower of great beauty and is characterised by a row of smaller or collar petals round the centre. These collar petals are generally distinct in colour from the rest of the flower—a fact which adds greatly to their beauty. *Century* Dahlias are a later development of the single flower in which the petals are broad and very regularly placed and the flowers are of huge size. This class was once popular only about 25 years ago in America, but European florists have not recognized it. The *Single Cactus* is another form of the single Dahlia. The petals are long, narrow and irregular, sometimes twisted at the tip. The *Pæony flowered* or *Art* Dahlias, though of very recent introduction, have created a sensation in the floral world. The flowers are semi-double, having two, three or more rows of broad, flat, loosely arranged petals, usually surrounding a conspicuous rich golden-yellow centre. The petals are often pointed, sometimes twisted, and in some varieties the inner row of petals twists and curls over the centre, giving the appearance of the Japanese Pæony. Hence its name. The blossoms are very effective and graceful, usually of a large size, and borne on long, stiff stems, making themselves very useful for bouquets and as cut-flowers. The plants also are of a very vigorous growth and taller than most other classes. Even this beautiful

class has been recently overshadowed in popularity by the Decorative, and very few commercial growers now offer this class. Besides the above, there are classes such as *Anemone-flowered*, *Star*, *Rosette*, *Colossal*, *Semi-Pæony* or *Duplex*, *Pompon-Cactus*, etc., but they are less important, and not so universally recognized.

Pot Culture

The Dahlia is also largely grown as a pot plant, but the size of the pots must be large. The roots usually sold by seedsmen and florists are of a small size, suitable for sending out to distant places, as they travel well and economically, and are known to produce as good flowers as large field-grown roots. As a matter of fact, the size of the tubers has little to do with the quality of the blooms. These small bulbs are very suitable for growing either in pots or in the ground, and under proper treatment they are quite satisfactory. When planting, cover the bulbs with soil to a depth of about 2 to 4 inches from the top. After one or two seasons' growth, the roots will increase to a very large size and can be easily divided as already described. In India, especially on the plains, it is generally found that some of the choice varieties deteriorate after two or three years and need to be replaced by imported bulbs.

Staking

As Dahlia plants are generally very brittle, they break when exposed to winds, and they need the support of strong bamboo or wooden stakes. But if the following plan is followed, it will be found that very little staking is required. When the shoots appear above the ground, remove all but the strongest one, and when this has reached the height of about 12 inches, or rather has made at least two sets of leaves, pinch out the top, leaving two sets of leaves. This will induce it to put forth branches from the base, near the soil, and so make a more sturdy plant, better adapted to withstand winds.

Exhibition blooms

If giant sized flowers are required for exhibition purposes, remove all but a few branches and, as soon as buds begin to form, feed the plants either with liquid manure or some other artificial stimulant. The buds are usually produced in threes. In order to direct all the energy into the centre one, the two outer ones should be removed as soon as formed. When the bud opens it will most likely be necessary to protect it from the sun by a hood, as some colours are easily injured by direct sunlight. The buds should also be protected from heavy rain. For keeping **Cut flowers fresh,** see hints on page 78.

Insects and Diseases

Dahlias are remarkably free from insects and diseases. But they are occasionally attacked by mildew when their environment is not satisfactory, and they have received a set-back from some unfavourable condition. This condition should be treated in its very early stages. An application of Copper Sulphate Solution or any standard fungicide, twice a week for two or three weeks, will be found very effective. But if the mildew has spread heavily, it will not yield to any treatment, and the best thing to do is to cut down the affected plants to within a foot or so of the ground and start an entirely new growth. If the plants are given an open situation and are kept growing by liberal and judicious watering and feeding, the new growth will be perfectly healthy.

Green Fly or Aphis will also sometimes attack the plants if their vitality is lowered. These are found on the underside of the foliage. A liberal use of tobacco dust, or spraying with tobacco water will soon destroy them.

Slugs, earwigs and beetles also sometimes attack them; but these insects are never numerous and if a careful watch is kept, they can be easily destroyed by hand. Slugs usually work at night and so must be searched for with a lamp at night. By leaving cabbage leaves about among the plants, the slugs may be induced to hide under them during the day time and thus can be easily discovered and killed. Earwigs seek shelter, during the day, in pots filled with hay or dry moss, and can be caught in that way. Soot is also a very good preventive and may be used liberally.

Cutworms also are destructive, especially of young shoots. A liberal sprinkling of air-slaked lime will discourage them. Even if some of the shoots have been eaten by them, more will readily form. The grower, however, need not be afraid of the above long list of pests, as it is seldom that they are really troublesome and hardly five in a hundred growers have any trouble with them. *(For other diseases, see page 89.)*

Care of Dormant Roots

The Dahlia has a perennial root but an annual stem. The plant dies down to the roots every year and starts a fresh growth at the proper season, after a few months' rest. We have described the Dahlia as a tender perennial; it is tender only in the sense that it cannot stand even a few degrees of frost. In places where frosts occur, the plants are killed by frost at a time when they have nearly finished their season's growth. After the tops have been entirely killed by frost, the roots should be carefully taken out of the ground. They should be freed from soil and dried in the sun for a few hours. After packing them in dry sand or saw dust or some such material, they should be stored until the next planting season, in a dry, cool cellar. Care should be taken to avoid the use of tin boxes, as they prevent air reaching the roots, thus killing them. Old deal-wood cases are eminently suited for this purpose. The wooden cases must be carefully closed down so that mice cannot get into them easily.

Time of Planting

Our thanks are due to the Superintendents of Government Gardens, Allahabad, Bangalore, Ooty, Pachmarhi, Trivandrum, Narsingpur, Maymyo, Benares State, Lucknow, and to the Agricultural Inspector, Khashi and Jaintia Hills, Shillong; the General Overseer, Arboricultural Works, Dacca; Superintendent, Municipal Gardens, Bombay; Secretary, Cawnpore Memorial Well Gardens, Cawnpore; Superintendent, Agri-Horticultural Society's Gardens, Teynampet, Madras; Director of Gardens, Kapurthala State; Manager, Kanauli Gardens, Muzaffarpur; Director, State Gardens, Gwalior State; Curator, Lloyd Botanic Gardens, Darjeeling; Messrs. Dijon & Sons, Ghatsila; The Secretary, Agri-Horticultural Society of India, Calcutta; The Curators of Botanic Gardens, Hakgala and Peradeniya, Ceylon; Director of Agriculture, H. E. H. The Nizam's Govt., Hyderabad, and others who have supplied us with valuable information especially about the time of sowing seeds and planting bulbs, etc., not only of Dahlias, but also of Cannas and Gladioli. The following information given about the time of planting in various parts of India, is culled from their letters with slight modifications.

DAHLIA (Continued.)

Places.	Time for sowing seeds	Time for planting bulbs.	Period of flowering.	Remarks.
Deccan, Konkan & Southern Mahratha Country.	Middle of May to end of June	June-July	Aug.-Oct.	Thrives very well and flowers satisfactorily.
Deccan Hyderabad	May-June	June-July	Within 3-4 months.	Thrives well with ordinary care.
Bangalore and vicinity.	"	May-June	Aug.-Oct.	Thrives well and flowers satisfactorily.
Madras (plains).	Sept.-Oct.	Oct.-Nov.	Dec.-Jan.	Does fairly well.
Nilgiris and Hill stations of S. India	Feb.-March	March-April	June-Sept.	Flourishes luxuriantly and flowers freely.
Travancore.	March	April-May	June-Aug.	Does but moderately well.
C.P., C.I., U.P., & The Punjab (plains)	Aug.-Sept.	Sept.-Oct.	Late winter and early spring.	Does not thrive well on account of the great heat from July to October. Where heat is not great and where rains fall during these months, they may be sown earlier during the monsoon, otherwise as indicated in 2nd and 3rd columns.
Pachmarhi and Hill stations of C. P. and C. I.	June-July	June-July	Aug.-Oct.	Thrives well and flowers satisfactorily.
Narsinghpur.	June	April	Within 3-4 months.	" " "
Lucknow.	May	July	After 5 months.	Does not do very well, and takes long to bloom.
Benares.	Sept.-Oct.	Sept.-Oct.	After 3-4 months.	Does fairly well.
Gwalior.	June-July	June-July (for early flowering). Also Nov.	"	Does not do very well.
Dacca and vicinity.	Sept.-Oct.	Oct.-Nov. (Also July for early flowering).	Early winter.	Does fairly well.

DAHLIA (Continued.)

Places.	Time for sowing seeds	Time for planting bulbs.	Period of flowering.	Remarks.
Tirhoot Division (Muzaffarpur.)	Sept.-Oct.	July.	Within 3-4 months.	Does well but requires much care and right treatment. (Bulbs, if not already sprouted, should be started by covering them with soil and watering them.)
Dum Dum and Ghatsila. (Bengal.)	April–June and also Sept.-Oct.	Sept.-Oct.	After 3-4 months.	Does very well and flowers satisfactorily. (Better results are obtained from the second sowing (of seeds) than the first.)
Calcutta.	September	September	„	Does well and flowers satisfactorily.
Hill stations of Northern India.	March-April	March-April	All through summer.	Thrives well and flowers satisfactorily.
Burma and Assam (Plains)	Early rains.	Early rains.	Within 3-4 months.	Thrives in places where there is neither an excessive rainfall nor great heat, during the monsoon.
Darjeeling. (Bengal.)	March.	April.	After 3-4 months.	Does very well and flowers satisfactorily.
Hill stations of Burma and Assam.	Jan.-May.	Jan.-May.	Within 3-4 months.	Thrives well under proper treatment. Time varies according to elevation and climatic conditions.
Maymyo. (Burma.)	May.	April–May	„	Does exceptionally well with ordinary care.
Shillong. (Assam.)	January	February	„	Thrives well and flowers satisfactorily.
Peradeniya. (Ceylon.)	May-June	Oct.-Nov. also May-June*	„	Thrives well and flowers satisfactorily. See also note below.
Nuwara Eliya. (Ceylon.)	Oct.-Nov.	Dec.-Jan.	„	Thrives well and flowers satisfactorily. Precautions should be taken to prevent damage by frost which occurs during December to February.

* Writing in August 1939, The Curator, Royal Botanic Gardens, Peradeniya, states: "We originally raise Dahlias from seed sown in May-June. These seedlings are planted out in Oct.-Nov. The seedlings form bulbs in the next six months and are lifted and rested for a week and planted as bulbs in May-June, and the procedure with bulbs is repeated in Oct.-Nov. Thus there are two plantings time for the bulbs—May-June and Oct.-Nov., but one only for seedlings, i. e., May-June."

DELPHINIUM (Perennial Larkspur)

Family, *Ranunculaceæ.*

All plants have charm, more or less. With some we must seek them, with others we find them at first glance. Delphiniums are the leading favourites of those who love hardy flowers, because they have virtues of unusual merit. Stateliness in appearance, massiveness in form and brilliancy in effect, are a few of their recommendable features. Their greatest charm is the loveliness of their shades which are unapproached by any other flower, and range from the palest blue and lavender to the darkest indigo and violet. The newer forms with immensely large flowers and bee-like centres, are remarkably striking.

The stately spikes will grow from 4 to 6 feet tall according to variety and, if cut back immediately after blooming, a second crop of smaller shoots will soon appear. On no account should faded flowers be allowed to remain on the plants.

Unfortunately, the Delphinium is a little difficult to grow from seeds, as its germination is usually uncertain. If seeds are placed in a refrigerator for 1-2 days, the germination will be found to be better and quicker. This applies also to Larkspur seeds. In India, it seems that the best time to sow, either on the plains or on the hills, is from September onwards. In places with light rainfall, and fairly cool weather during the rainy months, it may be sown at the beginning of the rains. The seeds take about 3 weeks, or sometimes more, to germinate and should be very carefully transplanted, either singly in large pots or in well-prepared, deeply dug and well-manured ground, at a distance of about 2 feet apart each way. They are known to bloom almost everywhere on the plains of India but on account of the higher temperature or heavy rains, the plants do not survive long. On the hills, they will live for years and increase in size. The *Chinese* Delphiniums are small growing, quick flowering plants and are grown as annuals with good effect. The *Belladonna* and the other new hybrid types which are truly perennial by nature, also flower the first season from seeds. In favourable weather they thrive better in the open but, during summer, they should be protected from the afternoon sun. It is recommended that growing plants be frequently nourished with either liquid manure, bone meal, or any stimulating fertilizer. Roots of old plants may be divided and replanted in fresh soil. But it is advisable not to disturb the plants for at least three years, after which they may be taken up, divided and replanted in fresh soil.

GLADIOLUS

Family, *Iridaceæ.*

This is a herbaceous plant growing from a solid fibrous-coated bulb (or corm), with long, narrow, plaited leaves and a terminal one-sided spike of generally bright-coloured irregular flowers. There are about 150 known species, a large number of which are South African, but the genus extends into tropical Africa and as far north as Central Europe and Western Asia. One species *G. illyricus* is found wild in England. But no species is known to have been found in India. Some of the species have been cultivated for a long period in English flower gardens, where both the introduced species, and the modern varieties bred from them, are very ornamental and popular. *G. segatum* has been cultivated since 1596, and *G. byzantinus* since 1629, while

Natural species

many additional species were introduced during the latter half of the 18th century. One of the earlier hybrids originated in gardens was the beautiful *G. Colvillei* raised in the nursery of Mr. Colville of Chelsea in 1823.

Its evolution

In the first decade of the 19th century, however, the Hon. Rev. W. Herbert successfully crossed the showy *G. cardinalis* with the smaller but more free flowering *G. blandus* and the result was the production of a race of great beauty and fertility. Numerous other crosses were made, but it was not till after the production of *G. gandavensis* that the gladiolus really became a general favourite in gardens. This fine hybrid was raised in 1837 by M. Bedinghaus, gardener to the Duc d'Aremberg at Enghien. Since that time innumerable varieties have appeared, only to sink into oblivion upon being replaced by still finer productions.

Modern types

The modern varieties of the Gladiolus have almost completely driven the natural species out of gardens, except in botanical collections. The most gorgeous groups—in addition to the gandavensis type—are those known under the names of *Lemoinei*, *Childsi*, *nanceianus* and *brenchleyensis*. The latest addition to these groups is the *Primulinus* type, which was discoverd a few years ago near Victoria Falls, South Africa. It was very floriferous, hardy, and bore the purest yellow flowers known among Gladioli. The hybridizers were quick to realise the possibilities of this type and having crossed it with various allied species and choice garden varieties, produced a class which is now very popular everywhere.

As a cut flower

The flowers of the best varieties are of great size and substance, often measuring six inches across, while the range of colour is marvellous, with shades of grey, purple, scarlet, salmon, crimson, rose, white, pink, yellow, etc., often beautifully mottled and blotched in the throat. The plants are vigorous in growth, often reaching a height of 4 to 5 feet. The stately habit and the rich glowing colours of modern Gladioli render them exceedingly valuable as decorative plants in the garden. They are also very desirable and useful for the purpose of room decoration, for while the blossoms themselves keep fresh for some days, if cut either early in the morning or late in the evening, the undeveloped buds open in succession if the stalks are kept in water, so that a cut spike will go on blooming for some time.

Cultivation

The Gladiolus is a flower of very easy culture and does well in any soil, but should have full exposure to the sun. When setting the bulbs, they should be covered at least with 3 to 4 inches of soil or even more, so that the new bulb, which forms on the top, will not be pushed too near the surface. Care should be taken to plant the bulbs right side up. On account of the small space the plants occupy, they can be planted very close. Where a large number is to be grown, either for mass effect or for cut-flowers, the bulbs may be planted as close as 2-3 inches apart in rows 6-8 inches apart. They can also be grown in small pots which may be brought inside the house when the blooms appear.

Being very responsive to liberal treatment, giant exhibition blooms can be obtained by giving them the best soil, cultivating it well and deep, and enriching it with the richest farm-yard manure, which must, however, be thoroughly decomposed. Liquid manure or pulverised sheep-manure can be applied to the soil once every week or ten days with advantage. The soil should be well-worked frequently, never allowing a crust to form on the surface. Water copiously whenever necessary, and stir the soil the day after watering. Do not work the soil when wet. Prepared ground-bone or any other high grade fertilizer, can be sprinkled over the soil near the plants, between rows, and raked in, to good purpose. Nitrate of soda (about a table-spoonful to 2 gallons of water per dozen plants) applied to the soil near the rows once every week or ten days after buds begin to show, is very beneficial. Or sprinkle the pulverised Nitrate of Soda over the soil, rake in, and water.

Manuring

The Gladiolus usually takes about three months or even less to bloom, according to variety and climate. It is advisable to remove the flower spikes as soon as they begin to fade, leaving a few leaves near the stock. When the leaves turn yellow, water should be gradually withheld and when perfectly dry, the bulbs should be carefully lifted, dried in the sun for a few hours, and then stored carefully like Dahlia tubers till next planting-time.

Only those who have seen Gladioli at their best can realise the vast difference between those produced by first-class methods, and those more or less left to grow by themselves. To obtain a continuity of succession of blooms, bulbs should be planted at intervals of every ten days.

The Gladiolus is easily raised from seeds, but takes from 2 to 3 years before it attains a flowering size. The named varieties are, however, propagated by means of the bulblets or cormels or "spawn" which grow round the parent bulbs.

Propagation

The best time for planting is about the beginning of the rains in places like the Deccan and Konkan. The Gladiolus is known to stand heavy rains, even upto 80 inches per year if planted in light, well-drained soil. In Bangalore, the bulbs are generally put down about the middle of May; on the Nilgiris, in March-April. In Madras, Gladioli have not been known to do well. In East Bengal, planting is best done in August-September, and sometimes again in November-December. On the Hill Stations of Northern India, during February-March, and on the plains about October-November.

Time of planting

(For diseases of Gladiolus, see page 90.)

GLOXINIA

Family, *Gesneraceæ.*

The treatment of the Gloxinia is more or less on similar lines to that of the tuberous-rooted Begonias. They are best grown in pots in a conservatory or fern-house, and with care can be grown during the rains in places with even fairly heavy rainfall like Bombay or Calicut.

NASTURTIUMS (Tropæolum majus)

(Indian Cress.) Family, *Geraniaceæ.*

There are few flowers which grow so easily or will repay the small amount of labour in planting with such a gorgeous and continuous display

of blossoms as the Nasturtium. Wherever grown, it has been a great favourite, and is wonderfully effective when planted in masses or in long rows on the lawn. They are very desirable for use in baskets or vases, elevated boxes, tubs, etc. They can also be grown as pot-plants during winter months. The climbing Nasturtiums are particularly useful as screens by growing them on fences, and produce brilliant flowers in a short time. As cut flowers also, they are quite satisfactory.

The Nasturtium is not particular as to soil, requiring only an ample supply of sunshine and good drainage. In shady places or in too rich a soil, it is apt to run to more leaves and few flowers.

Where the rainfall is light—say not over 25 or 30 inches—they can be grown during the rains; also during the cold weather, which is the best time. In the Punjab and in other places, where the nights are very cold and where frosts occur, it is necessary to protect the plants with some covering in the nights. In the hills, sow seeds in succession from March to May.

Both the flowers and young tender leaves of the Nasturtium (which have a delicately pungent flavour similar to that of Mustard or Cress), are gathered and used in making delicious sandwiches, in the same manner as Lettuce is. The seeds gathered while still green and tender, can be made into very appetising pickles. Even the flowers can be employed in decorating the salad-bowl, because they are not only ornamental, but edible.

The Dwarf or Tom Thumb varieties grow in compact, round little bushes and make very satisfactory plants for bedding. As Nasturtiums do not stand transplanting well, the seeds should be sown direct in prepared beds of moderately rich or even poor soil, at distances of about 9 to 12 inches, putting down two seeds in each hole about an inch deep, and pressing down the soil firmly over the seeds. As soon as the young plants are well above the ground and have formed two or three leaves, the soil should be worked with a hoe or similar implement, making the surface fine and loose to a depth of about two inches, and the young plants should be thinned out to stand only one in a place. Nasturtiums are liable to damp off or rot in wet seasons, if allowed to stand too closely together, and should be thinned out as soon as large enough to be easily handled. The beds in which they are grown must be made a little higher than the surrounding level, so that all extra water may drain away.

The Tall or Climbing Nasturtiums have no tendrils with which to clasp the support and hold the vines closely to it, such as in the Sweet Peas, but will twine and interlace their running branches over palings of the common garden fence, or meshes of wire netting, or they run rampant over ordinary pea brush (twiggy branches of trees or of bamboos) such as is used for garden peas. An effective method of displaying their bright flowers is to lay brush over the flower-bed when the plants are three or four inches high, and to allow the vines to twist and climb at will through the brush, which they soon conceal from view. Where open wire or light iron fences are used, a space about a foot wide is prepared alongside the fence, and planted with a single or double row of Climbing Nasturtiums. Treated in this way, besides making a beautiful display, they make a pretty edging

to the lawn. Planted in tubs or boxes, they can be grown either by themselves or a few seeds can be stuck in between the plants of Geraniums, Coleus, etc., for the vines or branches will run among the plants, concealing the soil, and then hang their long branches gracefully about the sides, and blossom freely. They are also effective when grown in pots on stands, or as hanging-basket plants or in vases.

The Canary Creeper (*Tropæolum canariense*) is a distinct variety, and makes a very beautiful small creeper with its fairy-like, canary yellow flowers, which are produced in great abundance if the plants are given a rich and deep soil and a cool season to grow in.

Double, Sweet-scented or "Gleam" Nasturtiums—This recently introduced class which has created a furore in the floral world has become so popular that an immense demand has been created for them and garden lovers are demanding newer shades in this class. Its habit of growth is semi-trailing and it produces giant-sized, *sweet-scented* flowers–2½ to 3 ins. across–on long stout stems. The flowers are composed of 8 to 10 petals in such a formation that they look like double. The distinctly sweet scent of the blooms is something entirely new in Nasturtiums and adds greatly to the value of this splendid new class. The introduction of this semi-trailing and the dwarf, double *Globe* types, has increased the popularity of this flower tremendously and the old-fashioned, single dwarf and tall classes are now neglected and grown by very few.

Double, Dwarf, Sweet-scented, Globe Nasturtiums–Upto now, the double Nasturtiums were not of perfectly dwarf, bushy habit but were semi-trailing. This class is uniformly dwarf and compact, producing deliciously scented, giant-sized flowers, on fairly long stems.

PANSIES

Viola tricolour maxima. Family, *Violaceæ.*

The Pansy produces the largest and finest flowers in a rich, loamy soil, and in a cool, moist climate. In hot, dry weather, the plants deteriorate quickly and produce small and inferior flowers. The seeds should be so sown that the plants flower during the most favourable season.

The Pansy is a hardy perennial in cold countries, and in favourable localities, flowers for many months continuously, producing large, bright coloured blooms. It is also greatly improved in recent years and many new and very charming shades of colours have been added and the size of the blooms also greatly increased. It is a great favourite with everyone and gives satisfactory results in all parts of India with a moderate amount of care.

It is adapted both for bedding out and as a pot plant. Being a cool weather plant, the seeds should be sown in September or October, so that the plants may bloom during the cold weather. In places where October is too hot, sowing may be deferred till November. On the hills, sow from March to May, and also in Autumn.

The chief essentials for best results are good, rich, loamy soil that will hold moisture well; frequent cultivation; removing faded flowers from plants so that they do not form seed-pods; cool, partially shady position and frequent applications of liquid manure or bone-meal.

Like many other flowers, the young plants (seedlings) should be transplanted twice before they are finally set out to flower in their permanent quarters. The plants should not be allowed to crowd, or they will become lanky or spindly. Even a third transplanting should be done if necessary. When the plants make good and healthy growth before producing flowers, they give best results. In warm weather, or in exposed, dry or poor soils, the plants are apt to bloom early, producing small indifferent flowers. A good mulch of manure on top of the soil, keeps the roots cool and benefits the plants.

When bedded out, the plants may be set at a distance of about 9 inches apart each way. When the plants have flowered for some months, they will show signs of exhaustion—the flowers will be smaller in size, the branches long and slender. If, at this time and before the plants have exhausted too much, the long old branches are cut back very nearly to the roots and the soil stirred and given some liquid manure or a mulch of any good well-rotted manure, fresh branches will be produced and the plants will again flower for some time more.

(For diseases of Pansies, see page 92.)

PETUNIA

Family, *Solanaceæ.*

This most pleasing annual may be fittingly described as everybody's flower. It succeeds everywhere, even under apparently unfavourable conditions, and no garden, however small, is complete without it. Given a sunny location, it can always be depended upon to furnish blooms in abundance, all through the cold weather and part of the hot weather.

The seeds are very small and need to be sown carefully. The tall class grows to a height of 18 inches or a little more and the dwarf about a foot high. They are grand as bedding plants and are also suited for growing in boxes, vases and hanging baskets. The *grandiflora* fringed and double varieties are simply superb and should be grown in every garden. The double Petunia seed is generally obtained by hand-fertilization and as the double flowers are sterile, the single flowers are crossed with double and bear seeds. Thus, when even the choicest double seeds are grown, some plants are bound to be single. While transplanting, care should be taken not to discard weak-looking seedlings as, generally, these produce the best and double flowers.

The above was written before the new "All-double" class was perfected a few years ago, and offered to the trade by an enterprising Japanese firm. It seems the double Petunia is now almost perfect, all good qualities such as size, colour, shape, height of plants etc., having been brought together in one class. This is a real triumph of the plant scientist and marks a great step forward in plant breeding.

The Petunia flowers best during the winter on the plains and the seeds should be sown at the end of the rainy season—say September-October. Being very hardy and able to withstand sun and heat it can also be sown any time during the cold weather when it will bloom in the summer. As it cannot stand heavy rains, it is not advisable to try it in the rains, unless the rainfall is very light—say not more than about 25 inches. On the hills, sow from March to June and also in October.

The seedlings, as soon as they are large enough to be easily handled, should be transplanted at a distance of about a foot apart or one plant to a medium-sized pot or basket. The tall Petunias have a natural drooping habit and so are well suited for growing in boxes or baskets. Choice plants of large flowering or double Petunias can be multiplied by cuttings like the Geranium or Verbena—as it is not a strictly annual plant but a biennial. When grown in pots, it is a good plan to use small pots at first and to shift the plants into larger ones as they grow.

Petunias have also been greatly improved in recent years. The advance is not only in the line of colours but also in size, and we have now nearly clear blues not found in the Petunia before. The deep, rich purples and violets are superb; the light pinks are dainty; the whites are showy; the striped sorts are fantastic; the giant doubles are marvels of the breeder's art, and the frilled sorts are popular. Altogether, the Petunia is a very satisfactory flower.

PHLOX

Family, *Polemoniaceæ.*

Phlox Drummondii is a native of the U. S. A. and was first discovered by Mr. Drummond, an American botanist, in Texas.

The brilliance and clean colours of the annual Phlox *(P. Drummondii)*, make it a favourite in every garden. No other flower can compare with it in variety of colour and profuseness of bloom. The flowers range from pure white to pink, primrose, scarlet, crimson, rose, lavender, and purple. Some are perfectly clear, while others have dark or white eyes. The plant keeps on blooming for months and furnishes quite a large quantity of flowers for cutting, as the plants branch freely and continuously produce new blooms. The flowers also last well in water.

It thrives best in an open, sunny situation and in a light, sandy, though rich soil. When well-grown and carefully watered, the Phlox is known to flower during the heat of March, April, and May in places like Poona and Bombay. It is excellent for masses in the border and for solid beds. The various coloured varieties when planted in the border may be so arranged as to form almost a rainbow of colours. Its possibilities for the decoration of lawn and border are not fully appreciated. A good bed of Phlox is a sight which dazzles the eye with its brilliancy.

The annual Phlox is a winter-flowering annual on the plains of India and is best sown soon after the rains are over—say from September to November. On the hills, sow from March to May—weather permitting, the earlier the better. In Madras and Southern India, sow in October and November. In places with light rainfall, say not over 25 inches or so, it can also be grown during the rains, provided it is given a light, sandy but well-enriched soil, and an open situation.

Seeds usually germinate within two weeks, and the seedlings should be planted out at a distance of about 9 inches as soon as they are large enough to be handled. The plants should not be allowed to flower until they have made some growth and are bushy. Remove all flowers from young plants to induce them to branch out. They will then produce better and more numerous flowers.

There are various strains of the annual Phlox. The dwarf class grows very compact and low, and is hardly more than 8-9 inches tall. The *Grandiflora* type is more popular and usually grows about 1-1½ ft. high. The *Cuspidata* or Star Phlox is an interesting form and worth growing, not so much for its beauty as for its curious, pointed petals. It is a little dwarfer than the *Grandiflora* type.

Perennial Phlox *(P. decussata)* is quite distinct and produces very large heads of beautifully coloured flowers, similar to the annual Phlox, on bushy plants about two feet tall. It is very difficult to grow from seeds, seeds taking an unusually long time to grow and being very uncertain in their germination. It is, however, easily propagated by side-shoots which spring up near the base, from the roots. The flowers have, in addition, the charm of a sweet scent.

(For diseases of Phlox, see page 92.)

SWEET PEAS (Lathyrus odoratus.)

Family, *Leguminosæ.*

Until recently, this very desirable flower was inaccessible to gardeners in Southern India, except on hill stations. In Northern India, it grows very beautifully and easily. Even in Poona, the old-fashioned Grandiflora or Eckford and Giant Spencer Sweet Peas do not flower at all well, and, except for the few who have grown the new early (or so-called Winter-flowering) Sweet Peas with success, most people think it impossible to grow Sweet Peas in Poona. With the introduction of the Early, Winter blooming Sweet Pea, it is now possible to grow it with quite a fair degree of success almost everywhere in India, provided the fundamentals of its culture are understood and intelligently carried out.

The Sweet Pea has been so much improved in recent years in size, shape, form, colour and freedom of bloom, that it is safe to say that no other flower has produced the same number of new varieties in such a short time. Hundreds of new varieties have been added to the old list, and the old-fashioned Grandiflora type has been entirely superseded by the new Spencer type with larger and frilled flowers. Then again, the introduction of the Early-flowering Spencer type has given an impetus to the popularity of the flower. Now, this type has been so much improved that we have dozens of new varieties of every shade of colour. Generally speaking, blue, lavender, purple pink and white flowers are more fragrant than scarlet, cerise and salmon colours.

The Sweet Pea plant or vine, which is closely allied to the common garden or culinary pea, succeeds best in a deep, cool, moist soil and will do well under similar conditions. The soil should not, however, be wet, and must be well drained. It must contain lime and should have an alkaline reaction.

To secure a long season of bloom and fine large flowers, it is necessary that the seeds should be sown as early as weather permits. Where the rainfall is very light—say, about 25 inches or so—and the climate cool and equable, the seeds could be sown at the beginning of the rains and also again in September and October. In other places, sow the seeds about September-October. On the hills, sow from March to May, and again in September-October. When sown on the hills of Northern India in October,

the plants, though they make very little top-growth in the winter, make a good root-growth, and flower long and freely the next spring and summer; but they should be protected from frosts during the winter, by means of straw, litter, etc.

The location should be open, away from trees and shrubbery where the plants get plenty of light and air. But, in places where the sun is very hot in the afternoons, it is advisable to select a plot so that the plants get some shade from the afternoon sun. They will grow in any good garden soil, but a rich clay loam will produce the brightest colours. The ground should be well prepared and dug deep—two feet being not too much—and a heavy application of well-rotted manure should be spaded under and thoroughly mixed with the soil. After the seed is sown, the ground should have a liberal top-dressing of manure. The plants of the Grandiflora and Spencer types usually grow about 4 to 6 feet tall and need the support of brush (twiggy branches of trees or of bamboos) which must be given when the plants are a few inches high. A trellis of some sort, or even an old tennis-court net or fishing net may be brought into service. Wire netting may be avoided as it gets heated in the sun and burns the vines. The Early or Winter-flowering Sweet Peas do not grow as tall as the old late-flowering types, and come into bloom at least a month earlier.

It is not advisable to plant either Peas or Sweet Peas in the same plot for more than two years in succession. They should be planted in a different place each season, unless grown by the trench method, in which the old soil is taken out and replaced by new soil and manure.

The seeds may be sown in drills about an inch to two inches deep and about two inches apart in the drills, covered with soil, firmly pressed down, and watered. The drills may be 3 to 5 feet apart in deep, rich soil, and where the weather is favourable to the cultivation of this plant. In other places, where the season of growth is not long enough, or where the soil and other conditions are not very favourable, the plants do not grow thick and tall, the drills may be quite close together—say, from 12 to 18 inches. Or they may be sown in small circular beds about 2 to 3 feet in diameter. When the plants come up and have grown a few inches high, the soil may be drawn near the stems so that the roots may be covered deeper with soil. They must be thinned out to stand at a distance of 4 to 6 inches apart, and must be given some kind of support to cling to, as soon as they are 3 to 4 inches high, or before they begin to fall down. An application of weak liquid manure or nitrate of soda (two ounces dissolved to a bucket of water and applied to 10 feet of row once a fortnight), will be found very beneficial. Keep the ground well cultivated to a depth of at least 2 to 3 inches, and do not allow the surface soil to become hard or packed. A mulch of manure or straw about 2 to 3 inches deep will be found useful. The flowers, as soon as they begin to fade, should be removed from the plants and never allowed to set pods as, otherwise, they stop flowering.

The trench system of planting, to which reference has been made in previous remarks, is practised where the finest flowers are desired. How this trench is made and planted is described under the heading of Peas (culinary) in Part IV of the Guide. Many other cultural hints given for culinary peas apply with equal force to Sweet Peas. These may also be looked up under that heading.

(For diseases of Sweet Peas see page 94.)

ZINNIA

Family, *Compositæ.*

Styles in flowers change with the seasons just as they do in clothes, houses, cars, etc. Some of the old-fashioned favourites of grandmother's day are now unknown, while others unheard of at that time or carefully avoided by particular gardeners, are now reigning favourites. In this garden parade, there is no flower that can equal the meteoric increase in popularity enjoyed by the Zinnia during the past 10 or 15 years.

Once shunned by fastidious gardeners, Zinnias are now given a prominent position in all gardens. This change is due to the remarkable improvement they have undergone and to the diversity of forms now available. It is, however, also partly due to its remarkably strong constitution and its ability to grow and flourish in hot, dry, and also in wet or moist weather conditions.

It is, perhaps, the best of our rainy and hot season annuals, growing in any soil and any situation and giving large, double flowers of various bright colours for months. The long, strong stems and the long keeping quality of the flowers, make them useful for cut flowers. They also make very showy beds.

It is so well adapted to our climate that it has become popular all over the country. It is one of our most useful monsoon annuals and is now largely grown for sale as cut flowers by florists in Bombay, Calcutta, and other cities. It is, in fact, an indispensable annual and never fails to give satisfactory results.

The Zinnia is also one of our quickest flowering annuals. The new Early Wonder variety blooms within 30 to 40 days after sowing seeds. The dwarf Mexican Zinnias bloom within 45 days and the other giant types within 60 days.

The time of sowing and the general cultivation of the Zinnia are about the same as for the Balsam, but it grows larger and should be given more space. The seedlings may be planted at a distance of about 1½ to 2 ft. in very rich soil. As the first flowers of the best double sorts often come out small and single, it is advisable to pinch off the first buds and not allow the plants to flower until they are quite strong. At this time, a little stirring of the surface soil and a top-dressing of some quick-acting fertilizer or liquid manure will greatly stimulate the plants' growth and the later flowers will be perfectly double and large.

The newer forms of Zinnias, notably the Dahlia-flowered, the Cactus-flowered or Quilled, and the California Giants, have greatly increased the popularity of this old-fashioned flower.

The old *Grandiflora* or giant type, though a bit stiff and formal, produces large flowers of various colours on bushy and rather tall plants about 3½ to 4 feet high. The flowers, though stiff, may be effectively arranged for house-decoration and show up most effectively under artificial light. There are many pure colours, and as these combine well, the effects possible are

charming. The dwarf or *pumila* class grows about a foot and a half high, and produces numerous medium-sized flowers and is well adapted for low beds. The *Haageana* or Mexican Zinnias are quite distinct from the ordinary *Zinnia elegans* and grow to a height of only about a foot, producing very small but numerous flowers of orange and yellow shades.

An entirely new variety—*Zinnia linearis*—made its debut only about ten years ago, and has captured public imagination and attracted great attention. It is entirely different from the popular *Zinnia elegans* and does not at all resemble it. It is an attractive little plant, growing about 8-10 inches high and blooming within 6 weeks, producing flowers continuously for several months. The flowers somewhat resemble in shape the single Mexican Zinnia and are deep golden-orange in colour, each petal marked at the centre with a delicate light yellow stripe, contrasting with a bold, dark brown, centre eye. It is very useful for low beds or for edgings and makes a blaze of colour in the garden. Unlike the other Zinnias which are annuals, this is a perennial and blooms month after month.

(For diseases of Zinnias, see page 95.)

FLOWERS FROM SEEDS FOR PARTIALLY SHADY PLACES

Very few plants will flower in places from which sunshine is entirely excluded. The varieties named below should have sunlight for at least two hours during the day, to produce best results.

Achillea, Anemone, Aquilegia (Columbine), Asperula, Aubretia, Auricula (Primula), Begonia, Bellis (Double Daisy), Campanula (Canterbury Bell), Coreopsis (perennial), Delphinium, Digitalis, Forget-me-not (Myosotis), Fuchsia, Godetia, Impatiens sultani, Lobelia, Matricaria, Mimulus, Nemophila, Pansy, Polyanthus (Primula), Poppy (perennial), Primula, Schizanthus, Torenia, Viola, Violets,

ROCK PLANTS

There are many plants which can be successfully grown as rock plants from seeds, a list of which we give below. This list includes only such plants the seeds of which can be easily obtained from seedsmen. Many other rock plants generally propagated by division of the roots or cuttings, are not included in this list.

Abronia, Achillea, Agathea, Alyssum saxatile, Alyssum dwarf, Ageratum dwarf, Anagallis, Anchusa, Aquilegia (Columbine), Brachycome (Swan River Daisy), Campanula carpetica, Candytuft (Perennial), Cheiranthus Allionii, Cosmidium, Cynoglossum (Chinese Forget-me-not), Daisy (Double or English), Dianthus plumarius, Dianthus, Sweet Wivelsfield, Diascea Barberae, Delphinium Chinese, Dimorphotheca, Eschscholtzia (Californian Poppy), Euphorbia, Geum, Gilia, Gypsophila (dwarf varieties), Heuchera, Kaulfussia, Linaria, Linum, Leptosiphon, Lobelia, Tagetes signita pumila (Dwarf Marigold), Nemesia, Nemophila, Petunia dwarf, Poppy (Iceland), Portulaca, Sanvitalia, Schizanthus, Sweet Peas Cupid or Dwarf, Ursinia, Verbena, Virginian Stock (Malcomia), Wallflower, Zinnia Haageana, Zinnia linearis.

CLIMBERS AND CREEPERS

(Easily raised from seeds.)

The following is a list of climbing plants–both annuals and perennials–which can be easily grown from seeds. Those which are marked †are perennials, the others are annuals.

†Ampelopsis, †Antigonon, †Aristolochia, Balloon Vine, †Bignonia, †Clematis, †Clitoria, †Cobæa, Convolvulus Major (Morning Glories), Dolichos, Humulus, Ipomœa, †Kudzu Vine, Maurandia, Mina, Climbing Nasturtium, †Passiflora, †Smilax, †Solanum (Climbing), Sweet Peas, Thunbergia.

PLANTS FOR EDGINGS

The following is a list of only those plants – annual and perennial – which are easily raised from seeds, and does not contain such perennial plants as Alternantheras which are only raised from cuttings. All of them are dwarf, ranging in height from 3 to 10 inches.

Ageratum dwarf, Alyssum, Anagallis, Brachycome, Candytuft perennial, Cerastium tomentosum, Daisy double, Marsh Forget-Me-Not, Leptosiphon, Lobelia dwarf, Marigold dwarf, Nasturtiums Dwarf, Nemesia, Nemophila, Nierembergia, Nycterinia, Pansies, Portulaca, Pyrethrum aureum, Sanvitalia procumbens, Tagetes signita pumila (Dwarf Marigold), Verbena.

FRAGRANT FLOWERS

The following is a list of annuals and perennials usually grown from seeds which have, more or less, a distinct, pleasing fragrance.

Alyssum, Candytuft, Carnation, Centaurea imperialis (Sweet Sultan), Freesia, Heliotrope, Mignonette, Nasturtium double sweet-scented, Nicotiana, Petunia, Pinks (Dianthus plumarius), Scabiosa, Stocks, Sweet Peas, Sweet Rocket, Sweet Wivelsfield, Sweet William, Wallflower.

FOR FOLIAGE EFFECT

The following is a list of such annuals as are easily grown from seeds for their pretty, ornamental foliage. This list does not include such perennial plants as Crotons, Ferns, etc., which are not easily raised from seeds.

Amaranthus (foliage), Asparagus (ornamental), Centaurea candidissima (Dusty Miller), Cerastium tomentosum, Coleus, Cyperus alternifolius (Umbrella Sedge), Euphorbia, Humulus, Kochia, Lamb's Ear, Pyrethrum aureum Ricinus, Zea (Ornamental Corn).

HOW TO KEEP FLOWERS FRESH

All flowers are best cut late in the evening, or better still, early in the morning. Strip off a portion of the foliage from the bottom of the stem, six inches or so. Plunge the ends of the stems in boiling water for 30 seconds, then place in cold water. If half a tablet of aspirin is added to a quart of water, it further helps the flowers to keep fresh.

Freshly cut flowers are a source of delight in any home, but at the same time they often are a trial and disappointment to the housewife because of their short life. This situation can be remedied somewhat by proper handling of flowers after they have been cut.

Pure, fresh water every day, kept at as low a temperature as possible, will do wonders. In addition, the practice of cutting off a bit of the stem each day aids in keeping the flowers alive.

Poppies, Heliotrope, Mignonette, Dahlias and Poinsettias will keep best if about an inch of the stems is plunged in boiling water shortly after the stems have been cut, and are then placed in cold water. Hot water seals the ends, prevents the sap from flowing downwards and permits absorption through the outer surface of the stems in parts higher up.

Chemicals such as charcoal and aspirin disinfect the water and consequently can be used as an aid in keeping flowers fresh. It has been found that the use of a 0.1 solution of boric acid (one in ten parts) will improve the keeping quality of Carnations three to seven days. Half a tablet of aspirin to a quart of water helps Chrysanthemums and Dahlias, but fails to do much for other blooms. One teaspoonful of cane-sugar to one quart of water will do much to freshen Asters.

In order to make vases of cut-flowers keep fresh for as long as possible, most people have their own pet method of treating the water. Some put an aspirin in the water, while others use pieces of charcoal, a copper coin, sugar, salt and so on. Now we find that scientists in Hawaii have been giving this matter attention and have discovered a new, scientific means of reviving and lengthening the life and freshness of cut-flowers

The treatment consists simply of using a 6 percent. solution of sulphurous acid in the water. It is very important not to confuse this *sulphurous* acid with sulphuric acid. Two teaspoonfuls of 6 percent. sulphurous acid are all that is needed for a quart of water, and it is not advisable to use it, for obvious reasons, in any kind of metal flower-vase or bowl. It is said that not only drooping flowers quickly revive when placed in this weak acid solution, but it adds days to the life of flowers, particularly in hot weather.

Another new hint for keeping flowers, such as poppies which so quickly drop their petals, is to melt a little gelatine and allow a few drops to fall in the centre of each flower. This soon sets and helps to hold the petals, thus prolonging their useful life as cut-flowers for a few days longer.

Always consult Index to Contents. Familiarise yourself with it. There are hundreds of good things in this book that will escape your attention if you do not use the Index freely.

INSECT PESTS AND DISEASES

The gardener's greatest enemies that take the largest toll of his produce and spoil the beauty of his gardens are the pests and diseases which plants are heir to. These attack plants with varying intensity at different periods of the year from the seedling stage to the seeding stage, i. e., during the full plant-cycle. The infection is even carried to the next sowing year through the medium of seeds, bulbs, or soil, where they hibernate—in dormant condition—till they again get their teeth into the new season's seedlings. In some seasons there may be only a slight attack; yet in other seasons plant pests and diseases can wipe out the whole garden.

No other animals bear such an intimate and complex relation to plants as insects do. The more luxuriant and varied the flora, the more abundant and diversified its accompanying insect fauna. If we examine any crop under normal conditions it is very rarely found altogether free from attack by insect-pests or diseases. Frequently, half-a-dozen or more different kinds of insects will be found to be attacking it, some eating the roots, others the leaves, some boring into the stem, some sucking the sap and some eating the buds of flowers or damaging the fruits.

How Pests and Diseases occur

Let us now see what produces the pests and diseases with such devastating results. Every species of insect or organism of disease faces a life-long struggle for existence. At least one of the following conditions is favourable to the existence of plant pests and diseases.

1. Seedlings grown in very moist surroundings which afford extremely favourable prospects for the disease-organisms.
2. The placing of large areas under one class of plants.
3. The introduction of non-indigenous pests from other countries.
4. Insanitary conditions in the garden.

It should be therefore the first attempt of every garden-lover to ensure that none of these conditions is allowed to be present, so that he will have taken the first effective preventive measure against his enemies.

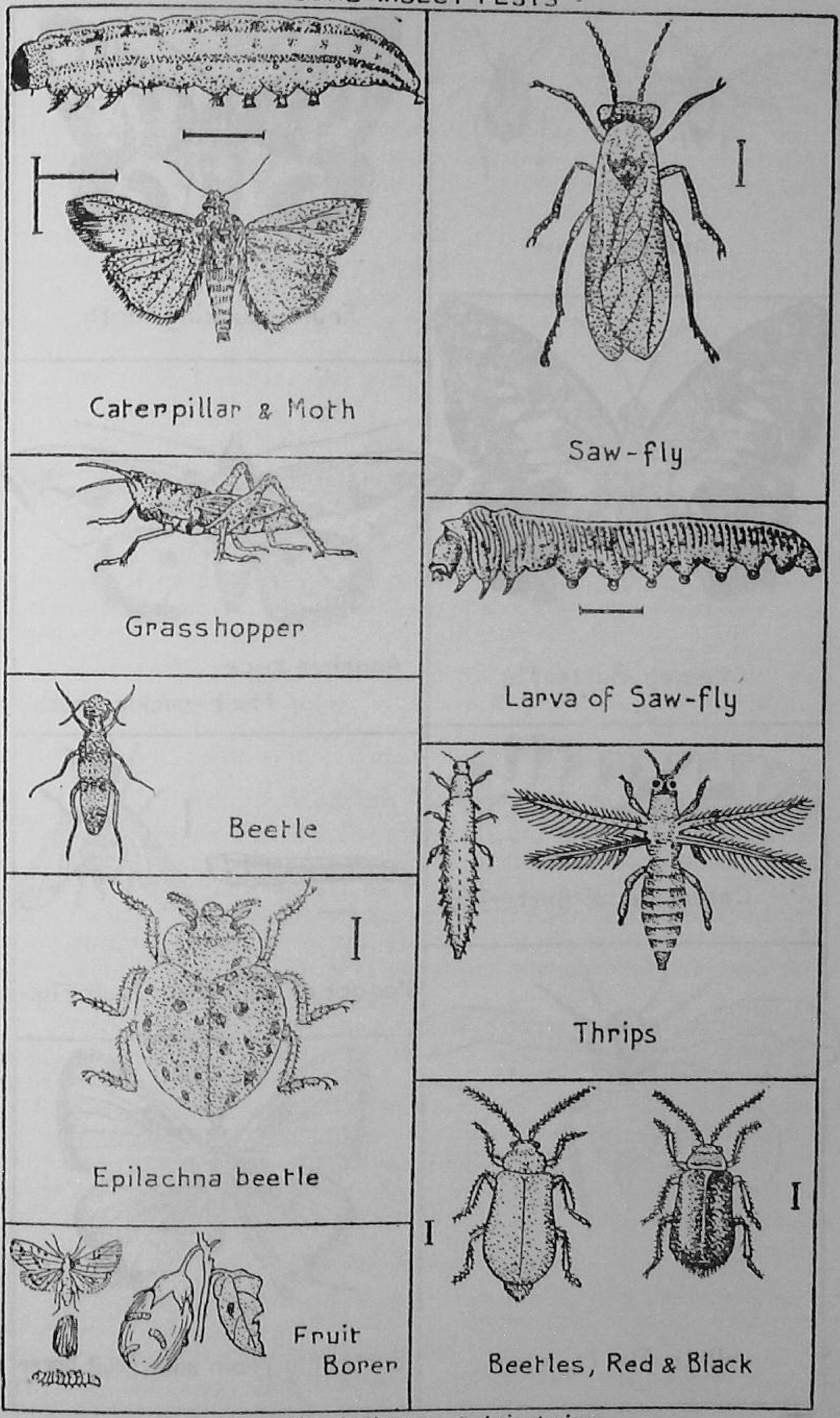
Control of Insect Pests and Diseases

The control of insect-pests and diseases depends on the application of common-sense methods based upon special knowledge of the insects and organisms concerned and of any particular circumstances under which they occur. For example, in the case of an insect pest of a crop some knowledge of the agricultural practice of the locality affected, together with a knowledge of the life-history of the insect in question, will often admit of the devising of a measure of practical control. The various means of control may be considered under four headings:—

1. Agricultural. 2. Mechanical. 3. Insecticidal. 4. Special.

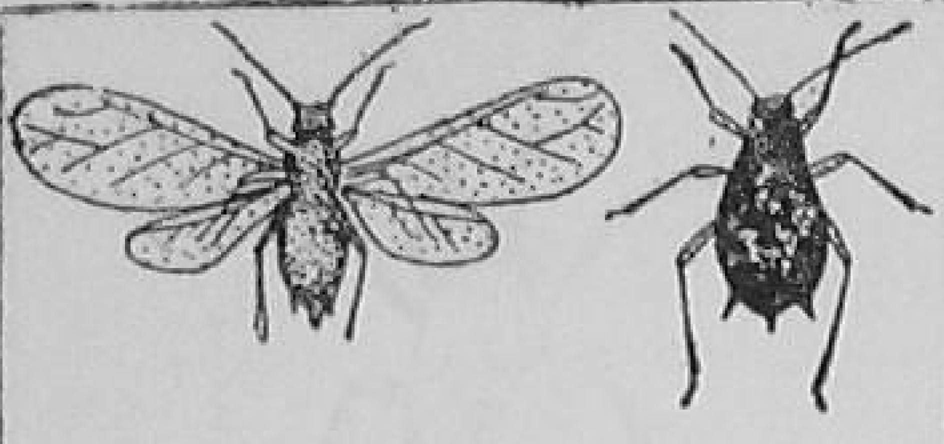
1. Agricultural methods aim rather at checking any undue increase of diseases than at actual control after they have attained destructive magnitude.

SOME INSECT PESTS

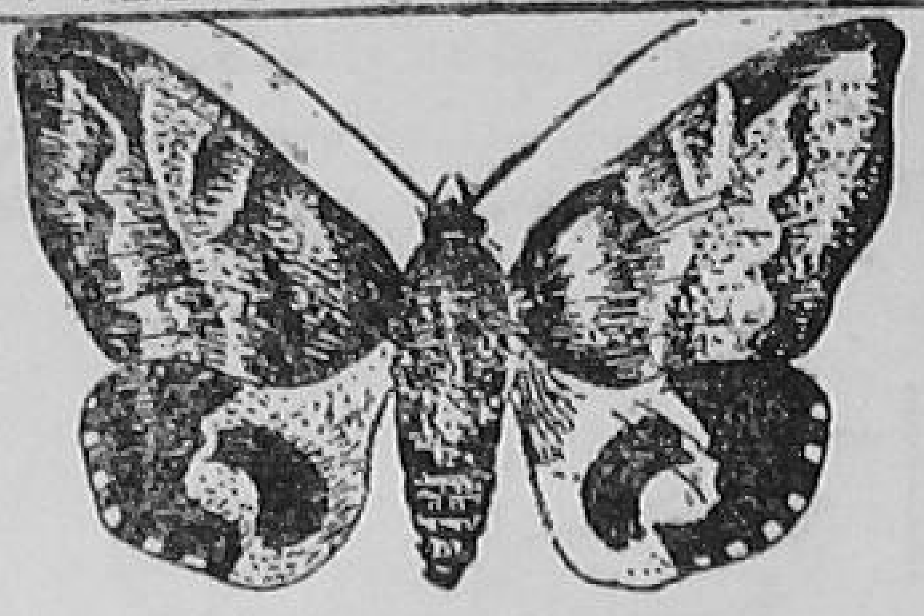


Black line indicates Original size.

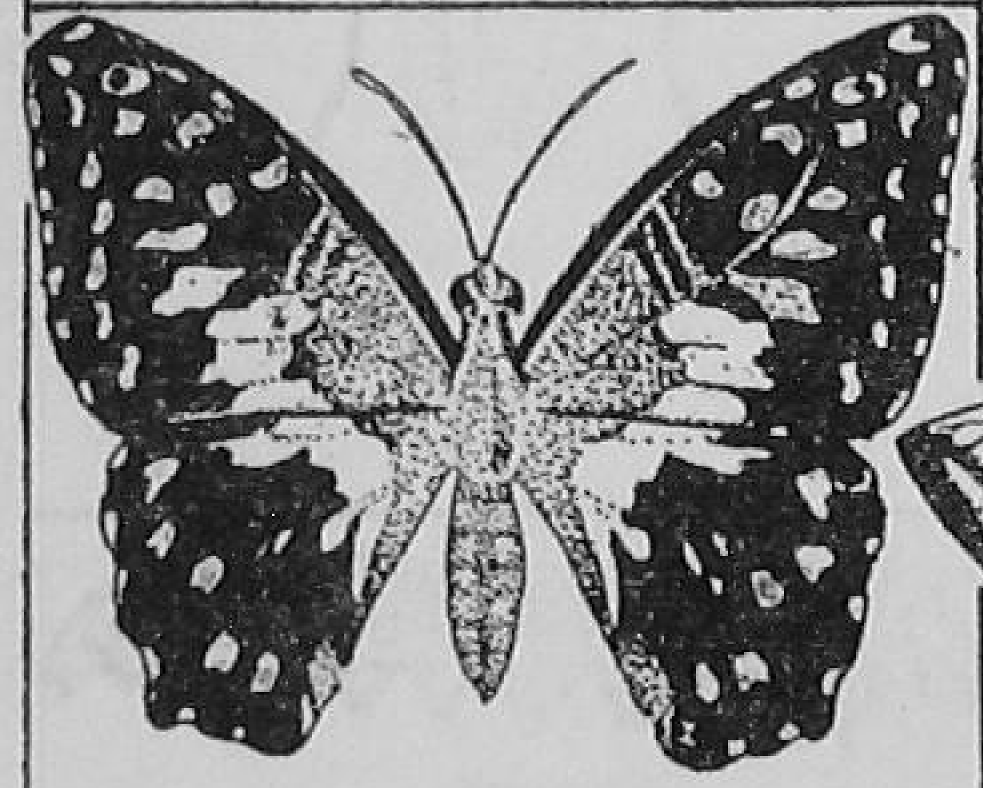
SOME INSECT PESTS



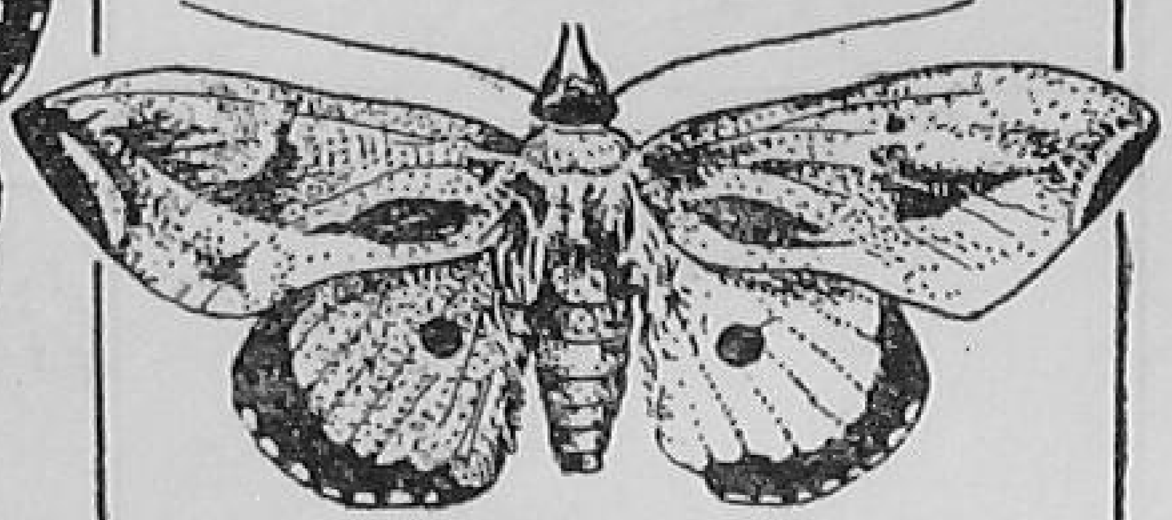
Aphids (1 MM)



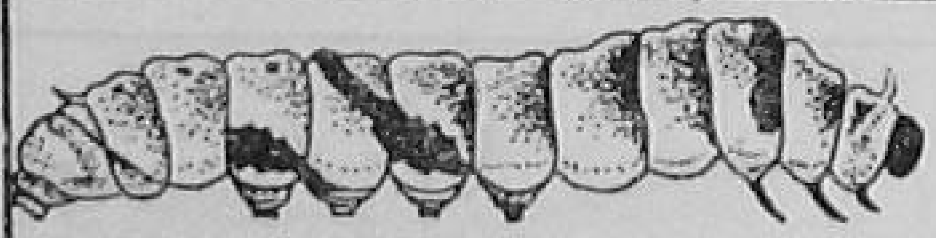
Fruit - sucking moth



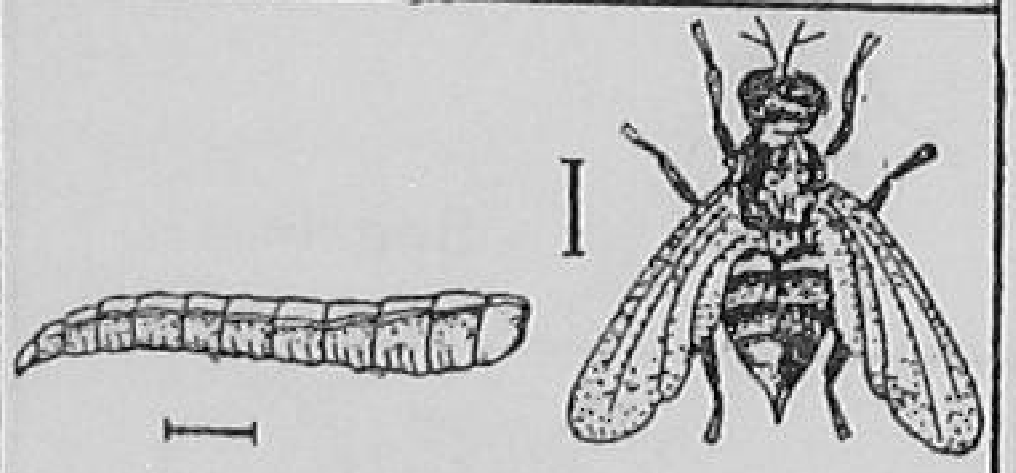
Lemon Butterfly



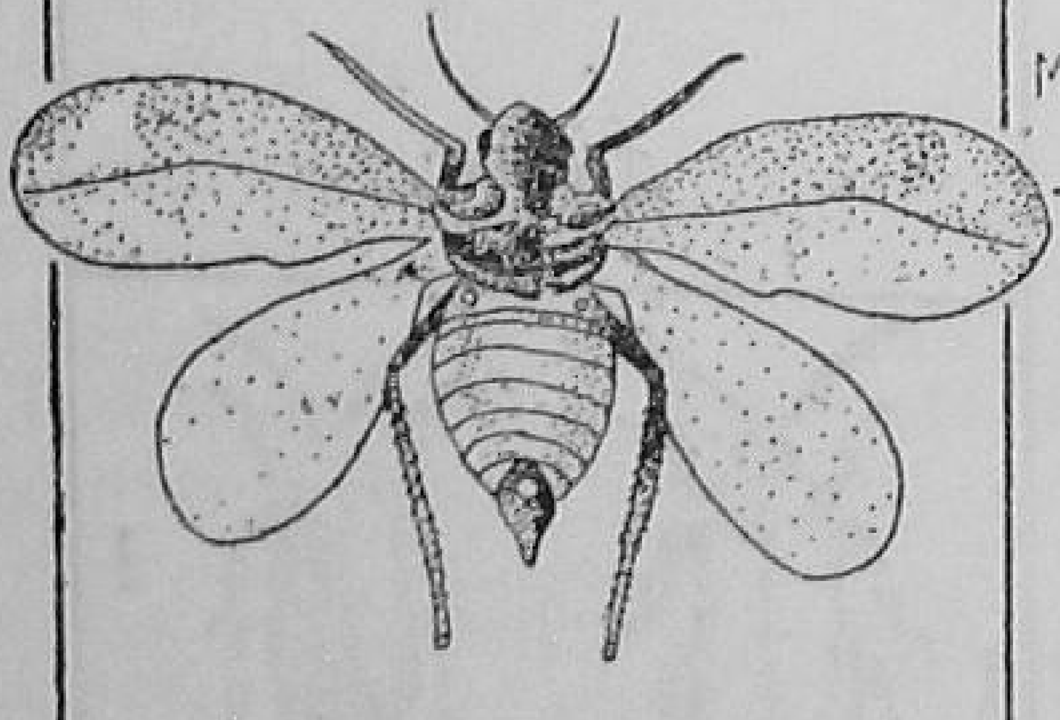
Another type of Fruit - sucking moth



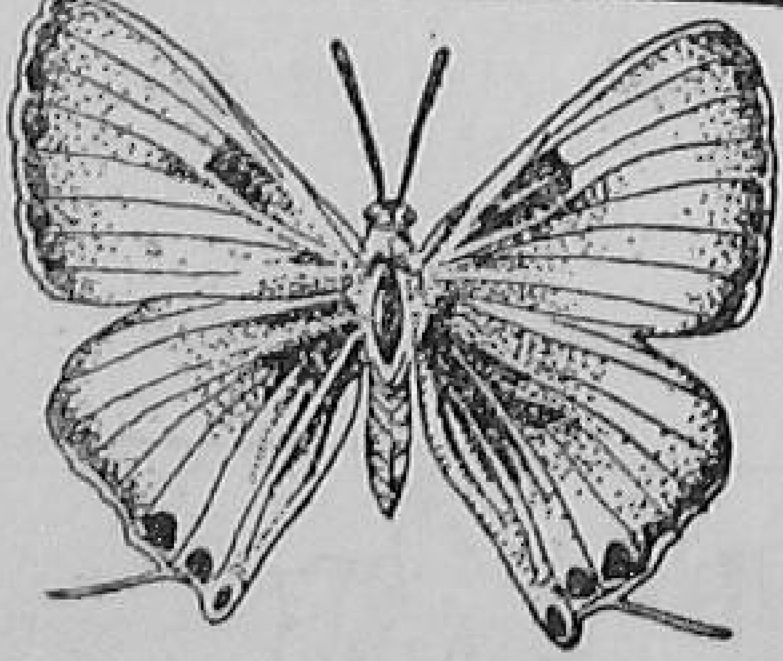
Caterpillar of Butterfly



Maggot of Fruit fly. Fruit fly.



White Fly (1/4 MM)



Butterfly from anar fruit borer

·Black line indicates Original size.

They include:—*(a)* Clean cultivation. *(b)* The proper rotation of crops or plants. *(c)* Growing of mixed crops. *(d)* Changing the time of planting. *(e)* The use of poultry and insectivorous birds. *(f)* Stimulation of plant growth by means of manures. *(g)* Irrigation and drainage. *(h)* Selection of resistant varieties. *(i)* Ploughing or digging of the soil so as to expose it to the direct rays of the sun, and even in some cases, burying the top layer of soil. *(j)* Removal and destruction of attacked plants.

2. Mechanical methods are intended to check increasing attacks of diseases and pests. Amongst these may be included *(a)* in the case of diseases—removing affected parts or even the whole of diseased plants; *(b)* in the case of insects—collection by hand, nets, light traps, attraction of baits and traps, trenching and burning, and removal of dead branches of plants.

3. Insecticidal methods are used when insects have attained such numbers as to become a pest. Some insecticides are used as deterrents or repellents, but as a rule they should be used when damage is imminent or actually being done.

Insecticides are usually applied in the form of powders and liquids; and they are divided into "Stomach-poisons" and "Contact-poisons". For their correct application, some knowledge of the insects concerned becomes essential.

Stomach-poisons are applied to the plants in order that they may be eaten by those insects which have biting mouth-parts; contact-poisons are applied to the insects themselves, and only incidentally to the plant, in order to suffocate insects with sucking mouth-parts.

Stomach Poisons

1. *Lead Arsenate* is sold in the form of a greyish paste or as a white powder. It is applied in the powdered form, but more economically as a liquid spray. The paste should be used at a strength of ½–1 oz. to four gallons of water; the powder at ¼–½ oz. per four gallons. The Lead Arsenate does not burn the foliage due to the fact that it is insoluble in water, and sticks fast to the leaves. It is a poison and care should be exercised in its use.

2. *Paris Green.* It is a violent poison and may be applied dry as well as in liquid form. In any case it should be mixed with lime in order to prevent the foliage being burnt due to any soluble arsenic. When applied dry, 16-20 times the same weight of hydrated or air slaked lime should be added and the mixture dusted lightly over the plants in the early morning. When used as spray—½ oz. to 4 gallons of water with 4 ozs. lump lime to be added to neutralize the soluble arsenic.

3. *Lime-Sulphur.* 3 gallons to 100 gallons of water.

Contact Poisons

1. *Crude-oil Emulsion*—20% soft soap + 80% crude kerosene oil. It is used at a strength of half a pint to a kerosene-tin of water, making certain that the mixture is properly strained.

2. *Fish-oil Resin Soap.* Useful only against young scaly bugs, aphides and soft-bodied small insects.

3. *Carbolic Acid Emulsion*—It is an emulsion made up of soft soap with Crude Carbolic Acid. It is diluted with 20 parts of water for use as spray.

4. *Tobacco Decoction*—Destroys grubs, worms, and small insects. Gives excellent killing results against soft bodied insects without harming foliage.

5. *Lime-sulphur* or only sulphur is useful against mites, powdery mildew, and against aphides.

Fungicides

1. *Bordeaux Mixture*—This is a mixture of copper sulphate and quicklime in equal proportions, and water. The addition of a little quantity of soft soap will be advantageous. The mixture is sprayed only on the affected parts.

2. *Sulphur*–Should be made into a fine powder and dusted–an ounce to an area of about 50 sq. feet. The irritation to the eyes of the workers caused by the sulphur dusting is easily counteracted by applying a solution of Soda Bicarb. as a preventive to the eyes.

Dry Slaked Lime—Used effectively for bacterial diseases—Bacterial Ring—of potato.

Tobacco Dust—Used also as a repellent for insect pests.

Spraying and Dusting Machinery

1. The Spraying Syringe is the simplest and cheapest form of sprayer and suitable for small gardens.

2. Bucket Sprayer, suitable for use with a bucket or a kerosene tin. It is simply a pump, with an adjustable foot-rest and a length of rubber tubing.

3. Knapsack Sprayers—These are fitted with straps and intended to be hung over the shoulders like a knapsack. Very handy and convenient.

4. Pressure Sprayers—Easily portable and easily worked and very economical in use as they do not waste any spraying material.

Special Methods

1. Fumigation of plants—This is a useful method for the treatment of a small number of affected plants to prevent extension of attack. The fumigant commonly used is Hydrocyanic acid gas produced by sulphuric acid on potassium cyanide. Plants should be fumigated, preferably in the evening, with great care.

2. "Ant-Exterminators"—White ants usually do much harm in a garden. This is a machine which pumps a hot poisonous gas in the subterranean burrows of the white ants.

Specific Enemies of Plants

1. **Fungoid Diseases,** such as the Downy and Powdery Mildews, Necrosis, Rusts, Anthracnose, Blight, etc. These are best prevented by spraying the affected parts with Bordeaux Mixture.

2. Bacterial Diseases—Damping Off—If a large number of cress-seedlings are grown together under very moist conditions it is found that they become "diseased". The disease begins at certain points and spreads in circles, and is caused by one of the species of Pythium. The disease can be stopped at an early stage by admitting abundant light and air, for

it can thrive only under moist conditions. Applications of a very dilute solution of sulphuric acid just after the seeds are sown is also found to be a preventive.

3. Bacterial Ring of Potato—Cutting the potatoes into pieces before sowing and dusting them with sulphur or lime.

4. Slugs and Snails—These frequently attack young vegetable plants especially on the hills and in parts of Ceylon. They are best checked by taking a bucketful of sawdust and moistening it with a mixture of 1 to 2 large cups of phenyle and 10 to 20 cups of water; the sawdust is then spread around the rows of plants to be protected or around single plants. During wet weather a stronger solution may be employed with safety to the plants as the phenyle is slowly washed out of the sawdust. Ringing the earth around the stems with lime is also sometimes successful.

5. Caterpillar Pests—These are most voracious creatures. They attack and eat away the stems, shoots, roots, fruits, leaves, and buds of flowers.

Control Remedies:—*(a)* Pick up by hand and destroy them. *(b)* Uproot the attacked plant and destroy it. *(c)* Spray stomach poison, especially for caterpillars that eat away the young buds of roses, etc. *(d)* Stem-borers of trees like the mango should be located first: then, a mixture of creosote and chloroform should be injected into the stem by means of a syringe. *(e)* Destruction by means of a light (i. e., illuminated trap) of adult female moths which lay eggs. This method may be effectively applied to the common pest of cereals and others, viz., the Amsacta species. *(f)* After the season is over the land should be dug up and exposed so as to destroy the pupæ which are usually laid in the soil.

6. **White ants or Termites**—They generally attack the hard woody parts and the dead parts of plants. They live in colonies underground in their nests. Therefore, to destroy them the remedy should be to locate such burrows and inject poisonous gases through pumping machines or to put petrol into the holes and then close them. Some specific ant-killers are also now on the market.

The following remedies could also be tried with success:—

(a) Dig out all neighbouring ant-hills and destroy, particularly, the "queen-ant" that is responsible for the production of colonies of white ants.

(b) When the attack of white ants is visible, water the plants with a very weak solution of phenyle—2 to 4 per cent.

(c) A few drops of coal-tar should be mixed with water in the channel, and the water directed towards the plants and shrubberies.

(d) Castor-oil cake should be applied round the plants. It has a deterrent effect on the termites.

(e) The formula given on page 79 is also a practical one.

(f) A very easy remedy to kill white-ants and workers is to level the ant-hill with a spade and then to bore holes two to three feet deep, about one foot apart on the levelled ant-heap, with the help of a crow bar. In these holes pour two

table spoonfuls of petrol and plug them with a fairly wet plaster of cow dung and earth in equal parts. The petrol fumes will kill the entire population of the white-ant colony. This remedy has proved very successful even on lawns where there is a constant attack of white-ants from the erupted ant hills.

7. Bugs, Beetles, Aphides, etc. These do not possess biting jaws and hence, the specific remedy to kill them is to apply contact poisons, such as Fish-oil Resin Soap, or Nicotine or Tobacco wash.

8. Beetles in flower beds and lawns can be destroyed by watering them with soap solution or phenyle.

How to Control White Ants (Termites.)

(Formula I)

We are obliged to the Publicity and Liaison Officer, Forest Research Institute, Dehra Dun, for the following very practical and simple method of destroying the mound-building species of termites. We may say that the chemicals recommended can be obtained from Messrs. Imperial Chemical Industries, Ltd., Ballard Estate, Bombay. Inquiries may be made direct to them.

As a result of experiments conducted for over 2 years at the Forest Research Institute, Dehra Dun, the Entomologist Dr. N. C. Chatterjee in collaboration with the Statistician Dr. K. R. Nair, has evolved a cheap and simple procedure for the complete destruction of the mound-building species of termites. Results now made available to the public are based on experiments with over 150 mounds of the termite *Cyclotermes obesus.*

The economic quantity of insecticide to be applied to any particular mound would depend on the size of termite colony in the mound. A prediction formula has been arrived at for this purpose; the volume of the mound is expressed by the formula $V = 1.4 (r^2 h) + 4.2$, where r is the radius of the mound and h is the height of the mound above ground. Both r and h are measured in feet to the first place of decimals, and so the volume is expressed in cubic ft.

Any one of the insecticides - DDT, Gammexane and Hexyclan – in a water solution may be used at the rate of $\frac{1}{4}$ oz. of insecticide in two gallons of water for every 10 c. ft. of mound. The solution is well stirred and poured after puncturing the top and sides of the mound. Complete kill of the entire colony including the queen termite is obtained in 24-72 hours. The cost works out approximately to 1 anna per mound.

The derivation of a simple formula for determining the contents of the entire colony in a mound has helped in evolving the correct and economic use of insecticides in treating termite mounds without having to resort to breaking and digging of the mounds or other expensive methods. It is hoped that this simple method will be adopted on a large scale in the extermination of termite mounds.

How to Control White Ants

(Formula II)

By S. M. Rafiqe, B. Sc. (Agri.),

Superintendent, Delhi Municipal Gardens.

These are also called termites and belong to the *Isoptera* order. Two species commonly found in Delhi are:—

1. Microtermes Obesus.
2. Termes Obesus.

Control:—i. Locate the nest and destroy the ants with any of the following methods:—

(a) Dig out the nest or mound.

(b) Pour kerosene oil or crude oil emulsion in the nest.

(c) Fumigate with carbon bisulphide or hydrocyanide gas obtained from calcium carbonate.

ii. To protect field crops, hedges and grassy lawns, apply crude oil emulsion in irrigation water at the rate of 3 gallons per acre.

iii. To protect fruit trees:

(a) Before planting trees, the pit should be well treated with crude oil emulsion. This can be done by mixing ½ lb. of crude oil emulsion and ½ ounce of arsenic in 4 baskets of sub-soil. The treated sub-soil is to be returned into the pit, to be covered with soil and trees be planted.

(b) Paint the trees upto 7″ above the surface with sanitary fluid using 6 ounces of sanitary fluid per tree. To protect the roots pour into irrigation ring 3 pints of fluid in 100 parts of water.

iv. House can be made white ant proof by drenching the floor with soda arsenate solution.

Formula:—1 seer crude arsenic.
2 seers washing soda.
8 gallons water.

v. Wooden posts:—Their basal portion should be painted with coal tar or salignum sodium fluosilicate should be packed round the base.

(**Caution**—Please note carbon bisulphide is highly inflammable. Some of the chemicals mentioned above are highly poisonous and great care should be taken in handling same.)

(The following article is reproduced from "The Gardener" for July and Oct. 1939 by kind permission of the author.)*

Microbes—Diseases—Pests

By RAMBLING MICROBE

Behind this modest *nom de guerre* is concealed the identity of a well-known professor of Nagpur University. This section on plant diseases, therefore, bears the stamp of authority.

Antirrhinum (Snapdragon.)

Anthracnose—This is a most destructive disease. Plants of any age are liable to infection. On the stem elliptical sunken spots are formed, and on the leaves globular red spots. Infected leaves are killed; they do not drop off the plants, but remain hanging. The diseased spots on the stem may completely girdle the stem.

Remove and burn all diseased plants. Transplant only healthy, well developed seedlings; spray with Bordeaux Mixture once a fortnight. Water the flower beds sparingly and, to ensure sufficient ventilation, do not over-crowd the plants in the bed.

Leaf spot and Damping off—Seedlings and young plants show typical signs of damping off. They rot at the base, and fall over at the soil level.

The fungus that causes this disease may also infect the base of stems of older plants. On the leaves are produced brown or black circular spots; usually they have circular ridges. The petioles may be directly infected or the infection may travel from the leaf to the petiole, and from the petiole to the stem which may later become girdled causing wilting of the parts above the diseased area.

Plant seeds and seedlings in sterilized soil; spray plants in flower beds with Bordeaux Mixture.

Amaranthus (Love-lies-Bleeding.)

Damping off and Foot-rot—The symptoms are the same as in other similar diseases and control measures are the same. See Aster.

Aster

Wilt—This disease occurs on plants from the seedling stage to the flowering stage. In the case of infection of young plants it may be mistaken for the foot-rot disease. Plants die off gradually from the early stage of their development. Old plants show distinct blackening of the stem, which, however, is not so marked in the case of younger plants. The wilting commences with lower leaves and proceeds upward until all the leaves have collapsed.

The disease is carried on the seed to healthy soil. Therefore, seeds should be treated with formalin (dip seed for 5 minutes in a solution of 1 pint of formalin in 50 gallons of water), or with mercuric chloride solution (dip the seed for 2 minutes in a solution of 1 ounce in 10 gallons of water) or dusted with sulphur powder or any other fungicide. It is essential to have clean soil in seed beds, or to disinfect the soil in seed beds.

* Formerly published by Pestonjee P. Pocha & Sons, Seed Merchants, Poona.

It is absolutely necessary to practise sanitation. Diseased plants should be destroyed by burning and not thrown on the manure heap. Flower beds which are infected with this disease should not be sown with aster for 2 or 3 years at least.

Wilt-resistant Asters—Aster wilt or Stem rot is caused by a fungus which resides in the soil and which infects the plant through the roots. The non-resistant variety of asters is susceptible to infection at any stage of the growth of the plant. The fungus can live in the soil as a saprophyte and so if the soil is once infected, it would be indefinitely unfit for growing non-resistant aster varieties. The spores of the fungus can be carried on the seed itself, and so new soil may be infected when planted with these seeds. According to the author of a booklet on asters, the only method of controlling wilt disease is the use of resistant varieties. Certain American seed firms claim to have evolved many wilt-resistant varieties which are up to the standard of original types and are in no way different. These new varieties are evolved through selection of commercial strains grown in infected soils.

A wilt-infected seedling may be easily mistaken for one attacked by damping off disease, but the wilt rot begins from the roots whereas the other rot is at the soil level. If a young plant having a few leaves is infected, it withers and dies. In the case of older plants there are two types of symptoms: in one, the plant is stunted, its growth is only on one side, and its leaves are yellow; in the other type the lower leaves wilt and the whole plant collapses suddenly, withers and dies. Such a plant usually shows distinct blackening at the base which extends some distance up the stem.

Aster Yellows—This disease does not necessarily kill the affected plant; it is wide spread in the United States and Australia.

This is a virus disease and is carried from plant to plant by the leaf hopper *Cicadula sexnotata*. These insects feed on a wide range of host plants and therefore it is not possible to eradicate this carrier totally. As some of the asters are perennials or biennials they are a source of danger for the spread of the disease on annual aster crops.

The leaf hopper can transmit the disease to a healthy plant only if it has previously fed on a diseased plant; the virus, however, must remain in the insect for a period of ten days before the insect can successfully transfer it to a healthy plant.

The first symptom of the disease is the appearance of a slight yellowing along veins of the young leaves. When a mature plant is infected, the old leaves are normal but the half-grown leaves show the yellowing along the veins, and the very young leaves are almost white but may have some green colour in them at a later stage. The flowers are malformed and greenish yellow in colour. The plant stands upright; there is also abnormal development of secondary shoots which gives the plant a branchy appearance. The whole plant is stunted in growth.

Infected plants should be removed and burnt. The disease is not seed-borne. Affected plants do not produce fertile seeds.

Foot-rot—The disease is found either in seed beds, especially when the seeds are sown in the early part of the rains, or a few weeks later after they have been transplanted. The damage is done chiefly to plants that come to flower during the rains and the loss occurs immediately preceding and during the flowering period.

The disease can be recognised by the sudden wilting of the leaves. The lower part and the roots show a distinct soft, wet rot; the plant therefore topples over at the soil level.

Seed beds and flower beds should be well drained. Treat the seed beds with formalin, as already described (see under "Damping off" on pages 9-10), if the seeds are sown during the rains. Plant out the seedlings in open and well ventilated flower beds, and well space the seedlings.

Thrips—See under Gladiolus.

Begonia

Bacterial Leaf spot—Disease spots are scattered all over the leaves. They are at first seen as tiny clear specks on the lower surface of leaves. Later they enlarge and become translucent, pale green or colourless spots.

Under favourable conditions large areas of the leaf are affected. Under moist conditions a soft rot is developed.

The plants should not be crowded together. In beds they should be well spaced. Watering should be regulated. Rapid forcing should be avoided. Sanitation should be practised.

Powdery mildew—All aerial parts of the plant are attacked. At first whitish circular spots appear as though dusted with a white powder; later they may increase in size and involve the whole leaf. The infected leaf becomes discoloured and may also be distorted in shape. An infected plant remains stunted in growth. Dust occasionally with finely powdered sulphur.

Carnation

Leaf spot—The disease is found both on the leaves and nodes of the flowering stock. The diseased parts lose their green colour and turn pale yellow or straw coloured and later they become shrunken.

Diseased leaves should be systematically removed and burnt. Spray occasionally with potassium sulphide, 10 oz. in a gallon of water, or Bordeaux Mixture (1-1-50), or a weak solution of potassium permanganate.

Wilt or Stem-rot—The disease can be recognised by the slow dying of the shoots one after another. They gradually lose their green colour and turn pale yellow. At a later stage all the shoots are involved. The roots show distinct signs of wet rot. At times the disease causes a "die-back" of the shoots. The uppermost node is the first to wither, and the disease travels downward.

The disease is encouraged by over watering and by water-logged soil. Infected flower beds should be sterilized and plants should be judiciously watered.

White tip—This trouble at times comes in the wake of the application of some fungicide or insecticide. White spots usually are found on the tip of the leaves or in the calyx of the flower, if the insecticide or fungicide is applied when drops of water are present on the plants. Avoid applying any fungicide or insecticide when the plants are wet with dew or mist.

Chrysanthemum

Leaf spot—Conspicuous black, more or less circular spots are formed on the leaves, which consequently turn yellow and drop off. The plants are badly defoliated, the defoliation commencing from base upwards. The defoliated plants are not in prime condition and bear poor blooms.

Avoid excessive use of nitrogenous manures and of water. Take care not to water the leaves. The plants should be given proper ventilation. To prevent spread of this disease, spray with Bordeaux Mixture to which is added sweet oil. This will prevent the fungicide being washed off the leaves. The first spraying should be given in August, followed by a second spraying a month later. If necessary, another spraying may be given in October.

All diseased material should be burnt and the soil given phosphatic rather than organic manurial dressings—the latter should at no time be excessive.

Ray-blight—As the name indicates the disease is on the outer florets or "ray" flowers. They are killed and so the buds open imperfectly.

Remove and destroy all diseased refuse; spray the plants systematically and repeatedly with Bordeaux Mixture as soon as the buds develop.

Powdery mildew—See Begonia.

Cosmos

Stem canker—Spots which are purplish at first are found on the leaves and nodes of the stem which consequently decay.

Uproot the infected plants and spray the lower parts of healthy plants with Bordeaux Mixture.

Dahlia

Powdery mildew—See Begonia.

Root-knot—This disease is caused by eel-worms. On the tubers large, irregular, swollen knots are formed. On the roots bead-like galls are developed.

Severely affected plants look sickly, are yellowish, and cease flowering. They may die prematurely or may remain stunted. If the infection is light the plants may look normal and produce flowers.

All diseased plants, even if lightly attacked, should be destroyed by burning. Bulbs from infected plants even if they look healthy should not be kept for the next season. All infected potted soil and pots should not be used for replanting next season, unless they are disinfected with formalin or heat. Soil in infested beds should be sterilized.

Geranium

Blossom blight and Leaf spot—Blossom blight is more common on double varieties than on single varieties. Flowers fade prematurely and the petal becomes dry. The diseased flower shows dark margins and rapidly wilts. The central floret is usually the first to be affected. On the leaves at first large circular spots are produced which later, in presence of moisture, enlarge, become irregular in outline, and may involve the whole leaf.

Sanitary measures will considerably control these diseases. Cutting beds should be sterilized. Regulate the watering. Do not wet the leaves and flowers. Space the plants so that there is sufficient ventilation and sunlight. Destroy by burning all affected parts of the plant as soon as they are discovered.

Stem rot—The first symptom of the disease is the blackening and rotting of the soft parts of the cutting below the ground surface. If the cuttings have rooted, the roots are soon destroyed. Diseased cuttings look normal at first, till the blackening extends to the parts of the cutting above soil level. Under warm, moist conditions the entire plant may be involved; it wilts and falls over on the ground.

Cuttings should not be planted in infected soil unless the soil is sterilized. Diseased plants and cuttings should be destroyed by burning. Cuttings should be taken only from healthy plants. No branch showing the least sign of blackening should be used as a cutting.

Gladiolus

Scab—This is a bacterial disease. On corms and cormels the disease produces yellowish-brown sunken round spots. As the disease progresses, the spots may run together; they become dark brown in colour or black. From infected corms it is difficult to remove the husk or the adhering soil on account of a gummy exudate. From a diseased corm diseased shoots are developed; on the leaves are found small reddish brown spots. The basal parts rot and the plant dies.

Treat the corms before planting for 8 hours in a corrosive sublimate solution made up by dissolving 4 ounces in 25 gallons of water.

Another method of treatment is to dip the corms from 5 to 10 minutes in one ounce of calomel dissolved in 1½ pints of water. The treated corms should be dried and stored in a dry, well-ventilated place till planting time. Rotation should be practised.

If the soil is infected as a result of planting untreated diseased seed, soil treatment is essential. Calomel should be mixed with the soil near to and above the corms. Six ounces of calomel will be required for treating 1,000 feet of row.

Destroy by burning all old trash two months after the plants have ceased flowering.

Hard rot—This disease is also carried by corms. Reddish hard rot-spots are formed on the corms. Plants from such corms are yellowish in colour and develop poor foliage and flowers. Badly diseased plants die prematurely.

Use for planting only healthy corms in uninfected soil. Treating the corms has not been successful.

Storage rot—The infected corms have reddish-brown sunken spots which are firm but not hard; sometimes they have irregularly concentric wrinkling. The rot extends into the flesh of the corms. The rotted flesh is slightly porous, firm and dry.

This disease occurs only under storage conditions. The infection cannot take place through healthy, unbroken skin of the corms but readily occurs through even the slightest wound. Therefore, store only healthy and uninjured corms. Any corm that shows even the least sign of a broken skin should be discarded.

Gladiolus Thrips—This is a relatively new insect but has spread widely both in Europe and America. Though we have not yet had reports of its prevalence in India, it is likely to spread here especially with the renewal of importation of these and other bulbs from foreign countries. It is very injurious to Gladiolus in particular, but also attacks amaryllis, iris, narcissus, freesia, aster, delphinium, and hollyhock.

The insect is about 1/16 inch in length, black or brownish black in colour, with a creamy white band across the base of the wings. They insert, in growing plant tissues, kidney-shaped eggs. They breed in the outdoor garden and breeding may continue on corms (bulbs) in storage. Injury to Gladiolus plants shows as a silvery appearance to the foliage, followed by browning and dying of leaves. Flower buds turn brownish and dry up and the blooms do not open properly.

If thrips are suspected on dry bulbs in storage, use naphthaline flakes. About a pound is enough for 1000-1500 bulbs. Put the bulbs in a bag with the flakes and tie it tightly to confine the fumes and keep for 3 to 4 weeks. Then remove the flakes. It will positively kill all thrips by gassing them. This treatment is to be given soon after the bulbs are dug up from the ground and are perfectly dry and not near to planting time. Another treatment is to use D.D.T. dry dusting powder—1 to 3 per cent. strength is enough. Use 1 ounce for about 30 to 40 lbs. of bulbs. Mix thoroughly. This process is to be used twice—first soon after the bulbs are dug out of the ground and then again, about 3 to 4 weeks before planting. Do not inhale the dust particles as they are injurious to human health. D.D.T. dust containing a small quantity of pyrethrum, sulphur or rotenone will also serve the purpose. It is not necessary to remove the dust after using it.

The above treatment applies to dry bulbs suspected of harbouring thrips. After the bulbs are planted, watch them carefully and if the leaves show silvery or grey appearance (followed by browning and dying of leaves.), dust the small plants with 3 to 5 percent. of D. D. T. dusting powder, repeating it two or three times at intervals of 10 or 12 days. If D. D. T. liquid spray is used, the wettable powder form is the best. In any case, the liquid D. D. T. should not contain any oil or oil emulsion base.

Hollyhock

Leaf-spot—Numerous small, irregular, light to reddish brown-coloured spots are produced on the leaves. These spots cause serious injury to the plants.

Old stems and leaves should be collected and burnt. The next season, the very young seedlings should be sprayed with Bordeaux Mixture. The spraying should be repeated once a week or a fortnight, two or three times. The ground about the seedlings and plants should also be sprayed.

Thrips—See under Gladiolus.

Iris

Scab and Thrips—See under Gladiolus.

Larkspur

Powdery mildew—See Begonia.

Bacterial leaf spot—This disease forms biggish, angular purple-black spots on leaves. Some varieties are more susceptible than others.

Collect and destroy by burning leaves and stems. This treatment will considerably reduce the infection the following year.

Crown rot—The disease is found just above and below the soil line. It rots off the stem at the base. At times a white fan-like growth can be seen on the ground and the rotting base. Once the infection takes place it rapidly spreads to other plants in the bed. Therefore, all infected plants should be uprooted and destroyed by burning. Collect and burn all trash round these plants. Soil round the diseased plants should also be removed and replaced by new healthy soil.

To control the spread of the disease in the infected planted bed, it should be opened up where planted too thickly. Rake the soil round the plants without injuring the roots and drench the soil with Bordeaux Mixture. Repeat the treatment every fortnight. The following season, larkspur, and other plants like cornflower, funkia, iris, pentstemon, susceptible to this disease, should not be planted, and the bed should be sterilized.

Lawn Grasses

Brown spots—The base of the grass stem rots and definite roundish, brown patches are formed in the lawn. This trouble is encouraged by heavy fertilization and frequent waterings. Acid soils seem to be suitable for the disease.

Spray with Bordeaux Mixture or treat the soil with one of the organic mercuric compounds now put on the market.

Pansy

Damping off—The disease chiefly occurs in the seedling stage. The seedlings die off in large numbers.

Treat the soil before sowing seed. (See under "Damping off" on pages 9-10). Sow seeds thin in seed pans. Do not overcrowd the seedlings. See Violet.

Phlox

Powdery mildew—The leaves are covered with a thick white powdery coating of the mildew.

Dust the plants with finely powdered sulphur.

Crown rot—The base of the plants rot off. See Larkspur.

Rose

Powdery mildew—This is a very common disease of roses. The first symptom is the presence of small raised spots on the upper surface. These are covered with a powdery white fungal growth. Under moist conditions the disease spreads rapidly and covers both the surfaces of the leaves and also young and growing parts of the plants. A badly attacked plant is stunted and suffers from defoliation. Flowers, flower-buds and twigs are also affected. Diseased flower stalks and calyx become red coloured and distorted in shape. Infected flowers are discoloured and flower buds do not open. Certain varieties like Edward, Mrs. Edward Mawley, Viscountess Enfield, Dean Hole, are most susceptible. Button Rose, Cluster Rose, W. R. Weddle, Betty Uprichard, Warrior, and Marechal Niel are wholly resistant.

Prune all diseased parts of the plants and spray with Bordeaux Mixture, or dust with finely powdered sulphur at the rate of half a pound per 100 square yards. The first treatment should be given as soon as the disease appears, i. e., in the first week of December and a second may be given if necessary a month later.

Plants should not be crowded together. Avoid planting in shady, poorly ventilated places.

Black spot—This is also a common disease of roses, especially of those with tender foliage, such as Ophelia. Many varieties of tea roses are to a certain extent resistant.

The chief symptom of the disease is the presence of irregular black spots. They are at first seen on the upper surface of the leaves or isolated and scattered areas. Later the major part of the leaflet may be black. Defoliation takes place.

Measures recommended for the control of powdery mildew will control black spots on leaves.

Brown canker—Hybrid tea roses are particularly susceptible to this disease.

Any part of the stem is liable to infection by brown canker. Initial infective lesions appear as purple spots. They later turn white. The canker is separated from healthy tissues by a reddish purple border. The initial infective lesion is found in the growing season and may remain dormant without causing any appreciable injury; in the succeeding season the lesions increase in size and form distinct cankers. Leaves and blossoms are also susceptible to this disease.

Diseased parts of stem should be pruned and burnt. Spray with Bordeaux Mixture in the growing season. If a plant is very severely cankered it should be destroyed.

Stem canker—The first symptom of the disease is the appearance of small pale yellow or reddish spots on the bark, which at a later stage forms a large cankered area. As the bark cracks, the wood tissue dries up. The stem may be wholly girdled by the canker and consequently the parts above the canker wilt.

The only effective remedy is to prune all affected parts of the plant and destroy them by burning. The cut ends should be coated with a fungicide or a wound dressing like Creosote Oil. A careful watch should be kept on plants, especially just before the growing season, and all diseased parts should be systematically pruned.

Black spot—Black circular spots are formed on the upper surface of leaves and also on the petiole. Infected leaves turn yellow and drop off prematurely.

Collect all fallen leaves from beneath the plants and burn them. This should be done repeatedly. Close planting should be avoided. Allow proper ventilation and good spacing; keep the plants away from walls and buildings. Spray frequently with Bordeaux Mixture or dust frequently with finely powdered sulphur. New growth should be well protected with a fungicide.

Sunflower

Powdery mildew—See Begonia and Phlox.

Sweet Pea

Powdery mildew—See Begonia and Phlox.

Seedling-root rot — The foliage of infected plants turns yellow. The vines are stunted, the basal parts and roots rot.

The flower beds should not preferably be manured; but if it is necessary to give farm yard manure it should be placed deep in the soil, and there should be a layer, about three to four inches deep, of ordinary garden soil covering the manure. Make a channel in the flower bed, plant the seed in the channel, and cover the seed with a thin layer of soil. As the seedlings come through, gradually cover the channel with soil. Cultivate the top layer of the soil round the plants, frequently sprinkle a little mixture of sulphur powder and lime around the plants. Practise rotation. If necessary, sterilize the soil as already recommended. (See under "Damping off" on pages 9, 10.)

Sweet William

Crown rot—See Larkspur.

Verbena

Powdery mildew—See Phlox.

Violet

Leaf spot—This disease causes considerable damage and is very destructive. All green parts of the plant are susceptible but most damage is done to the leaves. The disease can be recognised by the development of small, circular greenish or yellowish white spots, sharply delimited from healthy tissues by a ring, dark brown to black in colour. The spots rapidly increase in size and number and destroy the whole leaf.

Warm, moist weather is most suitable for the rapid spread of the disease. Weak plants, plants in crowded lacality, plants in shade are very much liable to infection. Plants should not be allowed to crowd together and should not be grown in water-logged soils. Plants should be judiciously watered. They should be grown in well lighted and well ventilated places.

Root rot—This disease does considerable damage particularly in the rains. The underground parts show a distinct wet rot. Affected plants look sickly and pale coloured. In the rains, the plants must be grown on a high bed in a sunny position, so that the soil does not remain water-logged; plants in pots or pans should be well drained and kept in a well ventilated place.

ZINNIA

Leaf curl—This is a very common complaint.

The plant grows well at first but later the leaves show definite signs of curling. In some cases there is also a change in colour from green to yellow. The plant ceases to grow, and remains stunted. Such a plant does not flower and if flower buds are developed, they do not mature.

It is suspected that the cause of the disease may be insects, like thrips.

Timely spraying or dusting with an insecticide like nicotine water will be effective. (For method of Preparing nicotine spray, see page 170.) Soon after the transplanted seedlings have got well settled in the flower beds, give a weak dose of nitrate of soda, and repeat the treatment a fortnight later.

Always consult Index to Contents. Familiarise yourself with it. There are hundreds of good things in this book that will escape your attention if you do not use the Index freely.

(The following article is reproduced from "The Gardener" July-September 1937, by kind permission of the author.)*

POWDERY MILDEW OF ROSES AND OTHER PLANTS

By M. N. KAMAT, B. Ag., M. Sc., College of Agriculture, Poona.

Roses are loved by all classes of people. Naturally "A rose for every Home" should be the motto for every home owner.

Roses, like other plants, are, however, susceptible to many diseases and pests. By far the most important is the Powdery Mildew locally known as **"Bhuri"**. The disease is specially severe on Edward rose and a few of the budded roses like Lavenir and La France.

Symptoms

The disease is easily recognised by the presence of white or pinkish powdery patches on the young shoots. Older parts are less easily attacked. Young growing shoots may be completely covered with mildew, not infrequently resulting in dwarfing and curling of the leaves and stems and distortion of the buds.

Cause

Powdery mildew is caused by a microscopic fungus parasite, which lives and feeds on the young shoots. The fungus spores are carried by wind to different parts of the plant as well as of the garden, where fresh centres of infection start. The mildew is widely prevalent on shoots after the October pruning as it requires a cool, dry weather for its growth and development.

The fungus survives from year to year as dormant threads on the old stems.

Control

There is hardly any disease which is so widely distributed and yet so easily and effectively controlled as the Powdery Mildew. Finely grounded sulphur (200-mesh fine) has been found to effectively control the mildew when applied as a preventive measure. The dust is best applied by either a crank type of dusting machine or a hand-bellows.

The first application has to be made as soon as the young shoots are about 4 inches long after pruning, to be repeated every ten days depending on season. The addition of 10 parts of Lead Arsenate to every 90 parts of finely divided sulphur will greatly enhance its effectiveness since the Lead Arsenate will also take care of insect pests.

In home gardens where the number of roses to be treated is small, an ordinary fine muslin bag will effectively serve the purpose of a dusting machine.

* Formerly published by Pestonjee P. Pocha & Sons, Seed Merchants, Poona.

(The following article is reproduced from "The Gardener" for April 1939, by late Prof. Dr. V. G. Deshpande, Professor of Entomology, College of Agriculture, Poona).*

COCKCHAFER BEETLES

Cockchafers are the cause of much damage to roses and grape vines at the beginning of the monsoon. The attack continues up to the end of August. The damage involves the destruction of leaves in a characteristic manner. The green leafy portion of the leaves is removed and only the skeleton consisting of veins is left. This damage is done by the beetles which are brown or dark brown in colour and about one-third of an inch in length. These beetles have a peculiar life history. It is the adult beetle which feeds on leaves at dusk and at night, the other stages being found at the roots of grasses in the soil. By day the beetles lie in ambush in the grassy area or in the soil round about the rose plants in a garden and emerge at night to destroy the leaves. This explains why the *mali* is often unable to find out the culprit destroying the roses in the garden.

Control

The beetle is attracted by light, and light traps are often useful in attracting the beetles and thus reducing their numbers. If an ordinary hurricane lantern is hung over a tub containing water to which kerosene has been added, the beetles are attracted to the lantern and fall in the kerosenised water and die.

Dusting rose plants with a mixture of Paris Green and lime is also very effective in controlling the pest. This mixture may be prepared in the following manner. Sprinkle water over a few pieces of stone lime of good quality. The lime slakes into a powdered mass which should be sifted through a muslin cloth. Mix 16 parts of this finely powdered lime (never use air-slaked lime as it is caustic to the plant tissue) with one part of Paris green, and this mixture should be applied to the plants by means of a hand duster or a muslin bag. The beetles feeding on the leaves at night will eat the poison and die. If Paris Green is not available, lead arsenate or calcium arsenate may be substituted, but when calcium arsenate is used, the proportion of lime in the mixture should be reduced from 16 to 10 parts, i. e., one part of calcium arsenate in 10 parts of lime.

Paris Green-lime mixture or lead or calcium arsenate-lime mixture is also useful in destroying such beetles as cause damage to flowers. The beetles are found hiding in flowers, and these can be collected and destroyed or the flowers should be dusted with the Paris Green-lime mixture. In fact, this mixture is useful to a gardener in preventing all kinds of damage done to plants by biting insects. For example, damage to jasmine shoots or leaves of zinnia caused by caterpillars during the monsoon can be prevented by dusting these plants with the mixture.

Paris Green-lime mixture or calcium or lead arsenate-lime mixture can be stored indefinitely without deterioration, and since it is a deadly poison, it should be so labelled.

---

* Formerly published by Pestonjee P. Pocha & Sons, Seed Merchants, Poona.

PART IV

VEGETABLES

Their Culture, Diseases & Pests.

CONTENTS OF PART IV

	Page
Cool and Warm Season Vegetable Crops for N. India Hill Stations	100
English Vegetables Grown under Heavy S. W. Monsoon Conditions	101
Artichoke	104
Asparagus	138
Beans, Broad	131
,, Cuba or Asparagus ...	134
,, French or Kidney ...	132
,, Lima	133
,, Runner or Pole ...	132
,, Scarlet Runner ...	133
,, Velvet	134
Beet Root	102
Borecole or Kale	109
Brinjal (Egg Plant) ...	146
Broccoli	109
Brussels Sprouts ...	110
Cabbage	110
,, Chinese or Celery (Pe-Tsai)	111
Capsicum or Chilli (Pepper)	144
Cardoon	105
Carrot	152
Cauliflower	112
Celery	153
Celeriac or Turnip-rooted Celery	154
Chicory	106
Chilli	144
Corn or Maize	130
Corn Salad or Lamb's Lettuce	156
Cress	113
,, Water	113
Cucumber	118
Egg Plant or Brinjal (Aubergine)	146
Endive	106
Dilpasand (Tinda, Tensi, Denshi)	119
Doodhee	119
Gourd, Bottle	119

	Page
Gourds, Sponge	121
,, White or Wax ...	121
,, Bitter	119
,, Snake	120
Ghee Turai or Luffa ...	121
Insect Pests of Melons, Pumpkins and Gourds ...	127
Kale (Borecole)	109
Karela (Bitter Gourd) ...	119
Knol Khol or Kohl Rabi ...	114
Lady's Fingers (Gumbo or Okra)	141
Leek	140
Lettuce	107
Maize	130
Melon, Musk	122
,, Water	124
Mustard	115
Okra	141
Onion	140
Parsley	155
Parsnip	155
Peas	134
Pepper (Capsicum)	144
Pumpkin	124
Radish	116
Rhubarb	143
Roselle (Red or Indian Sorrel)	142
Poi Sag or Poi Koi (Malabar Nightshade or Climbing Spinach)	103
Salsify or Vegetable Oyster	108
Scorzonera	108
Sea Kale (Under Swiss Chard)	103
Spinach	103
,, Newzealand ...	143
Sags	102
Sorrel (Red or Indian) ...	142
Squash or Vegetable Marrow	126
Swiss Chard	103
Tinda (Dilpasand)	119
Tomato	147,150
Turnip	117
Vegetable Marrow	126
Ruta Baga, Swede, or Russian Turnip	118
Water Cress...	113
,, Melon	124

Cool and Warm Season Vegetable Crops for N. India Hill Stations.

(The information given below is from a very practical and scientific book entitled "Southern Vegetable Crops", by Mr. George Whitaker Ware. Gardeners on hill stations of high elevations in N. India will find the information very useful as the conditions in their parts approximate closely to those described in the book.)

"Vegetables differ materially in their adaptation to high and low temperatures. The first group includes those vegetables which grow best under relatively cool conditions, and the second group includes those which can withstand high temperatures.

"The plants that will grow successfully in hot weather are so tender that their growth is checked when the air is cool and death results quickly if they are frosted. The tender crops are a little less susceptible to injury from cool weather than are the very tender crops. There is considerable variation in the soil temperature necessary for seed germination within the tender and very tender groups.

"The cool-season crops, on the other hand, can withstand light frosts. Some of them can even endure winter freezing, notably asparagus and rhubarb. Thus, it is this group of crops that one plants earliest in the spring and late in the season for autumn and winter harvest. These are the hardy and half-hardy vegetables listed below.

GENERAL CLASSIFICATION BY RESISTANCE TO FROSTS

Cool-Season crops		Warm-Season crops	
Hardy	Half hardy	Tender	Very tender
Asparagus Brussels sprouts Cabbage Horse-radish Kale Kohl-rabi Leek Mustard Onion Parsley Pea Radish Rhubarb Rutabaga Spinach Sprouting broccoli Turnip	Beet Carrot Cauliflower Celery Chard Chinese cabbage Endive Potato Lettuce Parsnip Salsify	New Zealand spinach Snap bean Sweet corn Tomato	Cucumber Cantaloupe (musk melon) Egg plant Lima bean Okra Pepper Pumpkin Squash Sweet potato Water melon

"The separation into hardy and half-hardy crops is based primarily on the ability of the seed to germinate at low soil temperatures and of the young plants to withstand frosts. This grouping does not necessarily apply to the full-grown plants. Carrot, beet, parsnip, and salsify can remain in the ground late in the autumn because of the protection given the root by the soil. In this sense they are more hardy than some of the so-called hardy crops."

English Vegetables Grown under Heavy S. W. Monsoon Conditions

(The following very helpful suggestions by an experienced English planter of S. India, we are sure, will be found very useful not only to planters in S. India but also to planters in Assam and elsewhere where similar conditions exist.

Capt. Nixon, having grown English vegetables on a small scale only, is not prepared to enter into correspondence with anyone on this subject.)

As a rule the English types of vegetables are not grown in India during the S. W. Monsoon months where *abnormal* rainfall exists. By abnormal I mean anything over 150 inches in the three months of June, July and August. During past years I have been making experiments with Messrs Pestonjee P. Pocha's seeds and find that provided certain varieties are *well up* before the heavy rain starts they do remarkably well. The seedlings should all be at least half grown by that time or otherwise they may fail to pull through. April and May are very hot months and yet it is in these months that the seed must be sown to produce good results. My experience has been that it is far more satisfactory to plant vegetable seeds in boxes or large pots in a shady position during these months and transplant into beds when the monsoon breaks. Seeds that have to be planted in beds and put under artificial shade during April and May are not altogether satisfactory and need expert attention which very few can give. Beds should be raised so as to prevent water logging and there should be plenty of depth of soil allowed. Excellent results can be obtained from carrots, tutnips, lettuce, radish and all of the cabbage varieties provided they are well forward befor June. Such vegetable as peas, beans and tomatoes generally fail under these abnormal conditions as the wind and rain plus lack of sun are against their thriving. It is impossible for me to mention here the numerous types of seeds which have proved highly successful under these adverse conditions but doubtless Messrs. Pestonjee Pocha & Sons can send those interested a list of them. The elevation here is 3200 ft. and rainfall between 150 to 250 inches most of which falls in June, July and August. I can thoroughly recommend certain varieties of Messrs. P. Pocha's seeds for these conditions.

(Sd.) E. M. Nixon,
Kadur District, Mysore State.

Note:—The vegetables tried and recommended by Capt. E. M. Nixon, are: Cape Cabbages; most of the hardy types of root vegetables, including the Ruta Baga Turnips (but not the Japanese Turnip "Shogoin"); Patna Cauliflower, Improved Long Orange Carrots. The head or cabbage type of Lettuces grow well but do not make heads. The Long Scarlet Radish

has proved hardy and can be sown during a break in the monsoon with good results. The Beet root has not proved hardy (but is well worth further trial, especially the early, round varieties), Sweet Corn also does well in the monsoon if *well staked.*

Though Capt. Nixon has not experimented with Indian Vegetables, we know that quite a number of Indian vegetables can be successfully grown during the heavy rains by sowing the seeds early in May and getting the vegetables well grown by middle of June in raised beds. English peas and beans are not satisfactory, as excessive rains seem to rot them and heavy wind is against good results. Tomatoes also do not do well.

AMARANTACEÆ FAMILY

SAGS

(Various Indian Spinaches)

Amarantaceæ Family.

Amarantus gangeticus; Amarantus polygamus, etc.

These are numerous varieties of tall, soft-wooded annuals extensively cultivated throughout India for the sake of their leaves which are used in the same manner as spinach. They are known by various names such as Lal Sag, Chowlai Sag, Marsa Sag, etc.

For practical purposes the cultivation of all varieties is very similar. The seeds are generally sown where they are to grow, rather thinly, in drills made about 1½ to 2 ft. apart, during late summer or early rainy months (June-July), either on the plains or on the hills. If the plants come up too thick, they must be thinned out to stand about a foot apart. Sow seeds at intervals of 2-3 weeks to maintain a succession. Water freely in dry weather and allow no weeds to grow. Any ordinary garden soil in which farm-yard manure is incorporated freely, will do.

The only notorious pest of this leafy vegetable is the weevil. Its grubs bore into top shoots and stem and produce gall-like thickening in them. The weevil is medium sized and ashy dark grey in colour. Both the adults and the young ones attack the crop and cause considerable damage. Control measures consist of nipping off the affected parts which is rarely practised.

CHENOPODIACEÆ FAMILY

BEET ROOT

Beta vulgaris. Chenopodiaceæ Family.

(*Hindi*, Chukandar.)

This is a hardy biennial, native of the sea coasts of Southern Europe, and cultivated for its fleshy roots. The short or round-rooted varieties are earlier, and better adapted to shallow soils than the long-rooted. The beet grows best in a deep, rich, well-manured and well-tilled soil. The seeds are sown where they are to grow, in drills about 15 to 18 inches apart at distances of about 2 to 3 inches apart. The seedlings are then thinned out to a final distance of about 6 inches. The young seedling plants should be carefully protected from sparrows who are very fond of them. If required for the home table, the roots should be pulled when about half grown and not allowed to mature.

On the plains, sow from August to November or even earlier—say in June-July—where the weather is not very hot and the rainfall not too heavy; and on the hills from March to May. One ounce of seed will sow a drill about 40 to 50 feet long. Four to five pounds are required to sow an acre. Table Beets are ready in about two months' time and Mangel Wurzels (Mangolds) and Sugar Beets take about three months or more to mature. The mangels are very extensively cultivated in cold countries for feeding cattle, as they keep very well throughout the winter. The average yield of Table Beets per acre is about 9,000 lbs.

To grow clean, handsome roots, the ground should not be rank or freshly manured. If a plot which has been heavily manured for a previous crop is available, so much the better. Otherwise, the roots will either overgrow in size or become forked and ugly. A little top dressing of salt is also advantageous.

Swiss Chard (Leaf-Beet, Spinach-Beet, Silver-Beet or Sea Kale Beet)—A distinct species from the common Beet (which is grown for its roots), the Swiss Chard is grown for its leaves. Cultivation is the same as that of the common Beet, except that the soil need not be so deeply dug. The seeds are sown in drills 16 to 20 inches apart and the plants thinned out to a distance of about a foot or more apart. The leaves are eaten, minced and boiled, like Spinach leaves. The mid-ribs of the leaves are stewed like Asparagus. An ounce of seed will sow a drill 100 feet long.

POI SAG or POI KOI
(Malabar Nightshade or Climbing Spinach.)

Basella alba and B. cordifolia. Chenopodiaceæ Family.

This is a perennial climber, with a red or white succulent stem, bearing alternate, oval-heart-shaped, slightly undulated, fleshy, rather large, green leaves, and is grown for much the same purpose as Sag.

Its cultivation is of the simplest. Plant it in any odd corner, and give it a support to climb upon; or it may be planted against trees or in the hedges surrounding the garden. Seeds are sown about the same time as other Sags described on page 96, or root or stem cuttings may be taken during the rains.

The leaves are eaten like Spinach and are abundantly produced with the least trouble. Deserves to be better known and more extensively used.

It is seldom grown on the hills, but would thrive if planted in late spring or early summer and will provide succulent leaves for some time until killed by frost.

SPINACH

Spinacia oleracea. Chenopodiaceæ Family.

(*Hindi,* Palak, Isfanj; *Kanarese,* Pinich; *Tamil,* Seemay Vasullay Keerai.)

Native of North-Western Asia. Annual.

Spain is supposed to be the first European country into which this plant was first introduced. It is a diœcious plant, bearing male and female flowers on different plants, the latter only yielding the seeds.

It is very quick growing, maturing within two months, and it can be grown between rows of late growing vegetables; the edible part being the leaves which are eaten boiled.

The cultivation of the Spinach is simple, but it grows best in cool weather, and in partially shady places. Quick, rapid growth is desirable with this plant so that the leaves and stems may be tender. It is important to have the soil as rich as possible and in fine tilth.

The seeds should be sown rather close together in drills about a foot apart, as their germination is usually less than average, about an ounce being used for every 100 feet of row, and about 10 to 15 pounds to the acre. After sowing, press down the soil firmly over the seeds, and if they come up too thick, thin them out at once to a distance of 6 to 8 inches as they grow. The soil should be frequently stirred and watered freely in dry weather. Flowering shoots should be nipped off as they appear. If extra fine and rapid growth is desired, use a top-dressing of nitrate of soda at the rate of 150 pounds per acre. This may be given in two applications, about every fortnight, soon after the plants get nicely started. If nitrate of soda is not available, a top-dressing of hen manure or well-rotted barn-yard manure is also beneficial. Plant at intervals of 2 to 3 weeks for a successive crop. On the plains, sow from September to December, even earlier—say in June-July—where the rainfall is moderate and the weather not hot. On the hills, from March to October. As spinach is hardy, it will stand freezing.

The English Spinach is not hardy in our climate and succeeds best only in cool weather. But the indigenous Spinach (Palak), which is of quite good quality, can be grown practically the year round, except during the hottest two or three months of the year. [For **New Zealand Spinach**, See page 143.]

COMPOSITÆ FAMILY

ARTICHOKE, GLOBE OR FRENCH

Cynara scolymus. Compositæ Family.

(*Hindi,* Hathichook; Kungor; *Tamil,* Atchowk.)

This perennial plant, which is a native of North Africa and Southern Europe, is not much cultivated in India, except in some places in the North, but in Europe, especially in France, Italy and Great Britain, it is extensively grown, almost every garden having at least a few plants. It is a large-growing, thistle-like, quite an ornamental plant and is fairly hardy in cold countries, requiring only a covering of leaves, straw or stable litter in the winter.

The fleshy scales and the soft base of the flower-heads are the much esteemed portions and may be eaten raw, but are usually boiled and served with butter sauce or as "Artichoke Salad," or are pickled after cooking. The suckers or young side plants when tied together to blanch are used as Asparagus, while the mid-ribs of the larger blanched leaves are used as "Chard."

It seems to thrive in many parts of India with little attention, and when planted in well-drained soil, will live through the heat and damp of our summers and monsoons.

The Artichoke may be propagated from seed, or by dividing the stools, or from suckers. The last method is the one most usually employed, as it is the only one by which the different varieties can be reproduced true to their proper character.

On the plains, seeds are sown from middle of August to end of October or earlier—say in June-July—if the weather is not hot and the rainfall not too heavy, and on the hills, from beginning of March to end of May. As soon as the seedlings are large enough to be easily handled, they are transplanted into beds in rows 4 feet apart, and about 2 feet from plant to plant in the rows. If the soil is very rich, a greater distance will be necessary. As the plant has a long tap-root, transplanting should be done carefully so as not to break the root.

Globe Artichokes will thrive in any good garden soil, especially in one which is loose and deep, though it will also thrive in heavier soils. Before planting, the ground should be deeply dug and liberally manured. The plants are greatly aided in their growth by wood-ashes and sea-weeds where procurable. A small quantity of salt will be found very beneficial, if added to the manure.

A plantation of Artichoke usually lasts from 3 to 4 years in cold countries and on hill stations, and can be renewed with success from year to year by offsets.

For the family garden, only a few plants will be required, as well-established plants produce a number of heads each year. These heads should be removed if not required, for, if allowed to ripen, they reduce the vitality of the plants. When gathering the heads, if the whole stem is also cut off near the ground, new suckers and flower-stems will shortly appear, thus keeping up a successive supply for a long period.

The seeds take from 10 to 14 days to germinate. An ounce contains about 500 seeds. The plants flower within 4 to 5 months after sowing seeds. About 12 ounces of seeds are required to sow an acre. The average yield per acre is about 4,500 lbs.

CARDOON

Cynara cardunculus. Compositæ Family.

This is a perennial plant, native of Southern Europe and Northern Africa, much resembling the Globe Artichoke. In the Cardoon, the leaf-stalks have been developed by cultivation; in the Globe Artichoke, the flower receptacle. It is a larger plant than the Artichoke and grown from seeds only. The seeds are first sown in seed-beds, and when the plants are a few inches high, are transplanted into trenches. The latter may be made about 15 inches wide, the same in depth, and about 4 feet from centre to centre. After having prepared the bottom of the trench to receive the plants by mixing the bottom soil with some manure, set them at a distance of about 18 inches apart and treat them as Celery, drawing the earth close to the stems as they grow and blanching them when they have sufficiently grown, by tying up the plants carefully.

This vegetable is very little known in India but succeeds well in Northern India. On the plains sow during September and October and on the hills during March and April. An ounce of seed will give about 500 plants or a pound is required to sow an acre.

CHICORY

Cichorium intybus. Compositæ Family.

(*Hindi,* Kasni.)

Native of Europe and several parts of Asia. Perennial. The common Chicory, which is found in almost all parts of Europe in the wild state, has been used from time immemorial for salads, and also as a medicinal plant. The roots, when dried, roasted and pounded, are used for admixture with coffee.

The seeds are sown in drills about one foot apart in any good, rich, well-worked soil, and the plants thinned out to a distance of about 4 to 6 inches. When the plants are intended to be blanched for salad, they may be thinned out to a distance of 15 inches apart, and when they have attained some size, they may be covered up with inverted flower-pots for a week or so, which will blanch them.

When the Chicory is stewed and served with melted butter, it bears some resemblance to the Sea Kale. More frequently, however, it is eaten in the same manner as Celery, with cheese. It also makes an excellent and very wholesome salad.

On the plains, sow during September and October; and on the hills from March to May. One ounce of seed will sow a drill about 200 feet long, or 4 pounds will sow an acre. It takes about 3 to 4 months to be ready.

ENDIVE

Cichorium endivia. Compositæ Family.

(*Hindi,* Kuru-Salad or Bilaeti Kasni.)

Native of the East Indies. Annual and biennial. The leaves of this quick-growing plant are eaten boiled or as a salad when blanched. Sow the seeds either in seed-beds or directly in the ground where they are to grow. Any good, fairly rich soil, will suit them. When the plants come up, set them in rows 1½ feet apart, and about 9 inches from plant to plant. If sown direct, thin out to the above distance. For blanching, draw the leaves together and tie them up, so as to exclude light from the heart of the plants, or cover the plants with inverted flower-pots, so adjusted that some air goes through the bottom. Blanching should be done on plants which are nearly fully grown, and it takes about 10 to 15 days. In watering, care should be taken that no water reaches the heart of the plants or they will rot. The Endive when properly grown and carefully blanched, is one of the best salad plants.

On the plains, sow from September to November or earlier—say in June-July—if the weather is not hot and the rainfall not too heavy; and on hills, from March to June and again in the autumn. Being hardier than lettuce, it is a very useful winter salad in the hills. An ounce of seed will sow a drill about 100 to 150 feet long; and about 3 to 4 pounds will sow an acre. It takes about 2 months to be ready.

LETTUCE

Lactuca sativa. Compositæ Family.

(*Hindi*, Salad, Kahu; *Kanarese*, Salady.)

The native home of this succulent annual is doubtful, but some think it to be Central Asia or India. It is one of the oldest vegetables known; the ancients were familiar with its cultivation and there are historical references which relate that lettuce appeared at the royal tables of the Iranian kings more than 550 years before the birth of Christ.

It is grown for the stocky head of leaves which it possesses. The latter, when crisp and tender, are universally considered to form the best salad material we have. There are two distinct classes of this vegetable—the Cabbage Lettuce and the Cos Lettuce, with further sub-divisions of both. The former class produces more or less a compact, globular head of leaves resembling the ordinary cabbage, and the latter an oblong or conical head, formed of narrower leaves which are somewhat spoon-shaped.

Its cultivation is quite simple. To give the best results, the plants must naturally be grown rapidly and without a check, and so a rich fibrous loam or a good garden soil should be selected and heavily manured. The seeds may be sown in seed-beds, and transplanted when large enough to be handled; or they may be sown direct in the ground where they are to grow. Make drills about half an inch deep and about 15 inches apart. Lettuce plants have comparatively small root systems and most of the roots are near the surface. For this reason, cultivation should be shallow—say not more than 2-3 inches deep.

Sow the seeds at the rate of about 25 to 50 to the running foot, covering them and pressing them firmly. When the young plants come up, they should be thinned to stand about an inch apart, and when these begin to crowd, every alternate plant should be removed for use. These, though very small, will be very delicate in flavour. The remaining plants, as they grow, should be again thinned out gradually. Heading varieties may be encouraged to form a head, by bringing the leaves together and tying them with a light string. This, of course, is not always necessary, as under proper conditions, the plants head naturally. The best heads are produced in a cool climate and in good soil. Watering must be done freely and copiously whenever needed; merely moistening the surface soil will not do. If the weather be hot, it is good to protect the plants from direct sun.

On the plains, sow from August to December, even earlier, say from June onwards, if the rainfall is not heavy and the weather not very hot. On the hills from March to August. To keep up a succession, seeds must be sown every fortnight. The seeds contain oil which makes insects and ants very fond of them; also sparrows and mice are partial to the tender seedlings. Therefore, care should be taken to protect the seeds from these pests. An ounce of seed will produce from 2,000 to 3,000 plants. A quarter of an ounce of seed will sow about a hundred feet of drill, and about two pounds are required to sow an acre. The average yield per acre is about 9,000 pounds. As the plants do not take up much room and are ready within 40 to 60 days, they may be planted between Cabbages or other late growing crops.

SALSIFY OR VEGETABLE OYSTER

Tragopogon porrifolius. Compositæ Family.

Biennial. Native of Great Britain and many other parts of Europe.

This delicious vegetable of which the chief edible part is the root, is far too little known in India. It is as easy to grow as Parsnips or Carrots, and has a distinct and inviting flavour, so much like the oyster, as to earn the name of Oyster-plant, particularly when it is boiled, sliced and fried in butter. It is nutritious and very wholesome. The tender young leaves make a good salad. The root is long and slim, white-fleshed and with a smooth whitish skin. The leaves are very green, long, straight and narrow, having a grass-like appearance.

It thrives best in a deep, rich, cool soil which is rather light than heavy, and requires a whole season in which to mature. Plant the seed direct in the ground in drills about a foot apart, covering the seeds about an inch deep, and allowing the plants to stand about 4 to 6 inches apart in the rows after thinning. As the germination of this seed is rather uncertain in dry weather, first test a few seeds, and then if they come up, sow the rest. Otherwise, soak the seeds in water for a few hours and then sow immediately. This usually helps germination. It is fairly hardy in cold countries and on hill stations of high elevation, and can be left out in the ground with a little protection during the whole winter. Or it may be lifted at frost time and stored like other roots. The yield per acre, under favourable conditions, is 100 to 150 bushels.

On the plains of N. India, sow during October or thereabouts. In other places where the rainfall is not very heavy and the weather not hot, sow from July-August to end of October. On the hills, from March to the end of May. About 1½ ounces of seed will sow a drill 100 feet long, and about 8 to 10 pounds of seed are required to sow an acre. The roots are ready to be pulled after about 100 days.

As its culinary uses are not much known, we give a few hints:—Wash and scrape 6 or 8 fair-sized roots, then cut into slices about 3 inches long. To prevent them from turning dark put immediately into three pints of water: add 2 table-spoonfuls of flour, one tea-spoonful of salt and a few drops of vinegar. Place them on the fire and cook for about half an hour, from the time the water begins to boil. Drain and serve with white sauce; or mix together and serve with one table-spoonful of salt, one tea-spoonful of lemon juice, one tea-spoonful of minced parsley or chervil. Serve at once. The roots may be boiled like Carrots or Parsnips or half-boiled and grated fine, made into small flat balls, dipped in a batter and fried like oysters.

SCORZONERA (Black Salsify)

Scorzonera hispanica. Compositæ Family.

Native of Spain. Perennial.

This plant is cultivated as an annual or a biennial. It has a fleshy tap-root, resembling that of the Salsify in size and flavour, but of black colour. It is grown in exactly the same manner as Salsify. It is much slower in developing its roots, which keep on growing in size if left in the ground, and is fit to be eaten even after a long period of growth. It has a

distinctly palatable flavour, and is said to be good for dyspepsia. The roots are used boiled, and the young leaves make good salad. In preparing for the table, the roots should be washed, not scraped, and boiled until soft, then peeled and served whole.

CRUCIFERÆ FAMILY

BORECOLE OR KALE

Brassica oleracea acephala. Cruciferæ Family.

This is a curly, loose-leaved plant of the Cabbage family, of a hardy character, capable of standing any amount of frost on hill stations, but not much grown in India. Its leaves are used as "greens." It cannot be recommended for general cultivation on the plains of India, as it is essentially a cold weather plant and frost and a high elevation bring out its best qualities. The curly leaves are very ornamental and a few plants grown in any garden are very effective.

Sow seeds in seed-beds and transplant when about 2 inches high into drills about 2 feet apart, setting the plants about 8 to 10 inches apart in the drills. On the plains sow during September and October; on the hills from March to May; also in Autumn. Half an ounce of seed will sow a row about 100 feet long, or 3 to 4 pounds will be required for an acre. It takes about two to three months to be ready. *(See p. 114 for diseases.)*

BROCCOLI

Brassica oleracea botrytis. Cruciferæ Family.

(*Vern.* Chhota Phool Gobee.)

The Broccoli, like the Cauliflower, is a cultivated variety of the wild Cabbage, and is grown for its head, which is similar to that of the Cauliflower. The Broccoli is a strain of late-maturing Cauliflower and has the property of being hardier in cold countries. The cultivation is the same as that of the Cauliflower. It, however, thrives best in cool locations and on well-tilled, heavily manured, clayey soil.

Its cultivation is successful only on Hill stations of high elevation. Most of the varieties are late maturing, producing flowers the next year On Hill stations of high altitudes, the best time to sow is during April-July. A mulching of manure should be given at the beginning of winter and the plants earthed up to the lowest leaves. The ground in which they are to pass the winter should be sweet and well drained, and the plants should, if possible, be protected in severe frosty weather. In March the heads begin to form and may be cut until June, if successive sowings have been made. These remarks apply to the white heading Broccolis which are very late maturing.

The *Sprouting Broccoli* is very early maturing, taking only from 100 to 125 days to be ready. They do not produce "heads" like other Broccolis but thick, fleshy, succulent flower shoots in the heart and also in the axils of the leaves, which are used like green Asparagus. The distinctive flavour and the green colour of the product along with the high vitamin content of the chlorophyll-laden shoots make a strong appeal to the appetite, and add variety to the supply of succulent vegetables.

The best time to sow the Sprouting Broccolis is from August to October on the plains and May to July on the Hills. *(See p. 114 for diseases.)*

BRUSSELS SPROUTS (Bud-bearing Cabbage.)

Brassica oleracea Var. Cruciferæ Family.

(*Hindi*, Choke Kobee, Goonee Goon, Bullatta.)

This is a tall-growing variety of Cabbage, but, instead of producing a single stocky head, it yields a number of small heads or sprouts on all sides of the tall stem, resembling in colour and texture the Savoy Cabbage. The cultivation is similar to that of the ordinary Cabbage, the seeds being sown on the plains from August to October, and on the hills from February to April; and also in Autumn.

Sow the seeds in seed-beds and transplant into rows about 2 feet apart, and 15 inches apart in the rows. An ounce of seed will produce about 1,500 to 2,000 plants and about 6 to 8 ounces are required to sow an acre. A well-grown plant usually gives from 50 to 100 sprouts, and takes from 3 to 4 months to be ready. If the tops of plants are pinched off when nearly fully grown, it helps them to set sprouts quickly.

(*For Pests and Diseases, see page 114.*)

CABBAGE

Brassica oleracea capitata. Cruciferæ Family.

(*Hindi*, Kobee, Gobee or Bandh Gobee; *Singhalese*, Goa; *Kanarese*, Kosugadde; *Telugu*, Kosugadda; *Tamil*, Mutta-Ghose, Kovise; *Malayalam*, Mutta-Ghose.)

The Cabbage is a hardy biennial plant, indigenous to the sea coasts of many parts of Europe and Western Asia, and is one of the vegetables cultivated from the earliest times. The ancient Greeks held it in high esteem, and their fables claim its origin from the father of their gods. The Egyptians are said to have worshipped Cabbage. The wild Cabbage, such as it still exists on the coasts of England and France, is a perennial plant and resembles the modern Cabbage only in its flower stems. In most of the Cabbages it is chiefly the leaves that are developed by cultivation; these, for the most part, become imbricated or overlap one another closely, so as to form a more or less compact head, the heart or interior of which is composed of the central undeveloped shoot with adjoined younger leaves. The shape of the head is spherical, sometimes flattened, sometimes conical. All the varieties which form heads in this way are known by the general name of Cabbages, while other kinds with large branching leaves, which never form heads, are distinguished by the name Borecole or Kale. In some kinds, the flower-stems have been so modified by culture as to become transformed into a thick, fleshy, tender mass; these are known as Cauliflowers and Broccolis. In other kinds, the leaves retain their ordinary dimensions, while the stem or the principal root, has been brought by cultivation to assume the shape of a large ball, as in the case of plants known as Knol-Khol and Turnip-rooted Cabbage or Swedish Turnip.

The best soil for the Cabbage is a rather sandy loam, not less than ten inches deep and perfectly well drained. Sow seeds in well prepared seed-beds rather thinly, sowing them not more than half an inch deep, either broadcast, or in drills which may be about 3 inches apart. When the plants are about 3 or 4 inches high, transplant them in a well prepared and richly manured soil, at a distance of about 1½ to 2 feet apart, in drills 3 feet apart. If the young seedlings are transplanted twice, first at a distance of about 3 to 4 inches apart each way and then in their permanent quarters, the result will be better. As the Cabbage is a gross

feeder, additional nourishment in the shape of liquid manure, or bone dust and guano in equal quantities, given to the plants while growing, greatly helps them to form large and solid heads. The latter may be used at the rate of about 300 to 500 pounds per acre.

On the plains sow from August to December. On the hills from March to August. An ounce of seed will produce about 1,500 to 2,000 plants or about 6 to 8 ounces will sow an acre. Early varieties take about 80 to 100 days to be ready; late varieties 100 to 120 days. From 5,000 to 10,000 heads could be grown on an acre of land, according to the variety and the distance at which they are planted. The average yield per acre is about 13,000 lbs. Cabbage heads should not be allowed to grow fully if required for the table. They are at their best when about three quarters grown. When a head of Cabbage has been cut, if the stump be left in the ground, it will send out side shoots and will frequently produce one or two small, nice heads.

It is well to remember that the seed-beds should not be as rich as the field into which the Cabbages are transplanted. Do not sow too thick or do not let the plants crowd in their seed-beds lest they come up weak and drawn. Never let them suffer for want of water at any stage of their growth. Do not put down all the seeds at once. It is better to put them down in succession, so as not only to have the heads over a longer period, but to make sure of at least a part of the crop, since there are many insect enemies. These appear at certain times only, and therefore, by division, the planter has a better chance. When transplanting Cabbages, choose a cool, wet day or one immediately after heavy rain, while the ground is wet. If these conditions are not available, transplant late in the afternoon or evening. Quick growing crops, such as Lettuce, Radishes, Beet, etc., may be grown between the rows of Cabbages, and will be out of the way before the Cabbages require the space.

Savoy Cabbage—This is another class of heading Cabbage and is distinguished by its finely netted and wrinkled leaves. It is supposed to be much better in quality than the smooth-leaved varieties. The cultivation is exactly the same as with the ordinary Cabbage.

(*For Pests and Diseases, see page 114.*)

CHINESE OR CELERY CABBAGE (PE-TSAI.)

Brassica sinensis. Cruciferæ Family.

Native of China. Annual. Though this plant belongs to the Cabbage family, it resembles a Cos Lettuce in appearance. It forms a long, rather full and compact head, or grows in a plain cluster of half-erect leaves of a light green colour and slightly crumpled or frilled at the edges. The leaves are tender and well-blanched in the heart. Tying the plants with strings greatly helps to blanch them better. It can be served as salad, like Lettuce, or boiled, minced and seasoned with butter.

The cultivation is the same as with Cabbages, only they may be planted a little closer together. They thrive best in cool weather and take about 60 to 70 days to be ready.

CAULIFLOWER

Brassica oleracea botrytis. Cruciferæ Family.

(*Hindi,* Phool Gobi; *Singhalese,* Malgoa; *Kanarese,* Hookosu; *Tamil,* Poo Kos; *Telugu,* Puva Kosu or Purgobi.)

In the different varieties of Cabbage known as Cauliflowers, it is the floral organs, or more properly speaking, the flower stems, which have been artificially modified in size and appearance in the course of cultivation. The flowers themselves have, for the most part, been rendered abortive, and the branchlets along which they grow, gaining in thickness what they lose in length, form a sort of corymb with a white, fleece-like surface. These floral branchlets, having become large, white, thick and very tender, produce nothing but a homogeneous mass, and the rudiments of the flowers are only represented by the minute and almost imperceptible prominences, which are found on the upper surface of what is termed "head" of the Cauliflower.

The cultivation of the Cauliflower is on similar lines to that of the Cabbage, though it is not quite so easy to grow. For its best development, the Cauliflower requires a cool, moist season for its growth, a constant supply of soil moisture, and a rich, light, loamy soil heavily fertilised. Thorough and frequent shallow cultivation is essential.

The seeds should be sown in much the same way as Cabbage seeds, and when heads begin to form, the leaves should be brought over and tied around the heads to protect and blanch them. This is not quite necessary, though it will help the plants to produce snow-white heads. The same object may be gained by simply bending one or two leaves over the head, partly breaking them, thus giving some protection from direct sun to the heads.

A top dressing of any good, well-decayed manure, when the plants are growing, considerably benefits them. To be sure of success, see that the plants suffer no check in their whole growth, otherwise they will grow only leaves and will not form a head. The plants should be encouraged to grow rapidly from beginning to end without a check, and still, notwithstanding all care, they will sometimes fail to produce the much-coveted head. This is due perhaps to a little unfavourable weather, too early or too late sowing, or to the selection of the wrong variety.

An ounce of seed will produce more than 2,000 plants, and about six ounces are required to sow an acre. Early varieties take about 90 to 100 days to be ready; late varieties from 100 to 130 days. The average yield per acre is about 9,000 lbs.

Though Cauliflowers of the best quality are grown only from choice and pedigreed seeds grown in Europe, we have in India, some fairly good acclimatised varieties, which have the merit of being hardier in our climate, standing our rains and heat better than the imported sorts. For this reason, the acclimatised varieties are used for the early sowings—from June to August, and the imported from September to the end of October. On the hills, use imported seeds only, sowing from the end of February to the end of April, and again in Autumn.

(*For Pests and Diseases, see page 114.*)

CRESS

Common or Garden Cress: *Lepidium sativum. Cruciferæ* Family.
American or Upland Cress: *Barbarea praecox. Cruciferæ* Family.
Water Cress: *Nasturtium officinale. Cruciferæ* Family.

(Cress: *Hindi,* Halion or Chansur; *Tamil,* Cressam-Keray.)
(Water Cress: *Hindi,* Pani Haleem; *Singhalese,* Kakkutu-pala.)

The Common or Garden Cress is a native of Iran and an annual. It is a plant of very rapid growth and of extremely easy culture. It can be grown in any ordinary soil, at all times of the year. In the hot months, select a shady and moist place in order to obtain more tender and more abundant leaves. The leaves are used as an ingredient in salad and also as a garnish. As the plants are ready for use in a few days after sowing, successive sowings should be made every 8 or 10 days. They make the best growth during the cooler parts of the year. On the plains the best time is from September to February or earlier—say in June-July—if the weather is not hot and the rainfall not too heavy. On the hills from March to September. Sow the seeds either broadcast or in drills. An ounce will sow a row 100 or more feet long. About 6 pounds are required to sow an acre.

The American or Upland Cress is a native of Europe and a biennial. This plant is a good substitute for the Water Cress which it much resembles, and its cultivation is simpler than that of the Water Cress. On the plains, sow seeds at the commencement of the cold season, in rows about 12 to 15 inches apart, letting the plants stand at a distance of about 6 inches apart in the rows. It is best grown in a cool, rather moist and partially shady situation. In places where rainfall is light, it can be sown during the rains also. On the hills, sow from March to May.

Water Cress—This is a perennial, and a native of Britain and other parts of Europe. It is an aquatic plant and grows along the margins of running streams, ditches and ponds, and on account of its pleasant and pungent flavour and its well-known hygienic properties, is highly esteemed for table use. The leaves form a favourite salad and are supposed to possess anti-scorbutic properties. It is very easily grown in almost all parts of India. Where a running stream is not available, it can be grown along the sides of a water channel where well water is used. The seeds are started by sowing rather thinly in ordinary seed-beds, by the side of the water channel and are so arranged that water can be made to run through the beds as required. When the seeds are sown, keep them just wet, and do not flood, until the plants are able to take water about 1 to 2 inches deep, without appearing over-submerged. As the plants will not thrive in stagnant water, fresh water should be taken into the beds as frequently as possible and kept flowing for some time. When required only for a small kitchen garden, it can be successfully grown in pots in partial shade and watered profusely three times a day. An ounce of seed will give at least 500 plants, and 2 to 3 pounds are required to sow an acre. If the seeds come up too thick, thin out the plants about 6 inches apart each way. When once established, they grow very quickly and spread rapidly. Water Cress can also be propagated by cuttings where they are obtainable. On the plains, sow from Sept. to Nov., or even from July onwards in places where the weather is not hot. On the hills, from March to June.

KNOL KHOL OR KOHL RABI

Brassica oleracea caulo-rapa. *Cruciferæ* Family.

(*Hindi,* Ganth Gobee; *Kanarese,* Navil Khol Gadda; *Telugu,* Nulu; *Tamil,* Navil Khol.)

This plant belongs to the Cabbage family as already explained under the heading of Cabbage.

Cultivation is similar to the Cabbage, but as the plants require less room, they should be put down closer—say in rows about 1½ feet apart and about a foot apart in rows. The seeds are either first sown in seed-beds and then transplanted or are sown direct where they are to grow. The latter method generally produces better roots. Thin them after they come up, at the proper distance apart, when they have made a few leaves. They are at their best when they are quite young and tender, when about 2-3 inches in diameter, and sowings therefore may be made frequently, say every two weeks or so—to ensure a longer supply.

On the plains, sowings may be made at the same time as Cabbage or earlier—say in June-July—if the weather is not hot and the rainfall not too heavy. On the hills, from March to end of May. On hills of medium or low elevations, the best time is in Autumn. An ounce will produce about 1,500 plants, or when seeds are sown by the hand in drills, an ounce will sow about 300 feet of drill. About 1½ to 2 pounds will sow an acre. They take from 65 to 85 days to be ready for the table after sowing the seeds. The average yield per acre is about 25,000 pounds.

PESTS AND DISEASES ASSOCIATED WITH THE CRUCIFERÆ FAMILY

Cabbage (*Brassica oleracea capitata*) Cauliflower (*B.O. Botrytis*) and Knol Khol (*B.O. Caulo rapa*). All these types of vegetables, including Brussels Sprouts, Borecole (Kale) and Broccolis, being of the same species the diseases are common. The more common diseases are:

Club Root (*Plasmo-diaphora brassicae*)—Only cabbage is affected. The other species are comparatively free. Radish is also subject to an attack by this disease. The organism lives in the soil and enters the roots and causes characteristic swellings on the root. The control method lies in clean cultivation and removing all old roots. A preventive dose of an insecticide CYCLOSAN at the time of planting is now advocated. Application of a heaped tea-spoonful of CYCLOSAN to each dibble hole at the time of planting helps in preventing the attack.

Black Rot Only cabbage is affected both in the nursery and the field. It is a seed-borne disease. The leaves turn yellow and droop, and the plants ultimately die. Treatment is preventive being soaking the seed in one per cent. mercury chloride solution for half an hour, before sowing.

The Mustard Sawfly (*Athalia proxima Kl.*)—The adult is a soft dark red wasp slightly bigger than a honey bee. The larvæ is greenish grey about an inch, which is a leaf eater. The pest also causes damage to radish, mustard, etc. Lime dusting or use of stomach poisons has been found useful for control of the pest. Hand picking is the usual practice.

Diamond-back Moth (*Plutella*)—A well known world-wide insect pest of the crop, whose caterpillar is small slender pale green, feeds on the foliage. The moth is a very small one and has pale white marks on its wings giving diamond like appearance in wings while the moth rests. Stomach poisons have been found very effective the latest among which is the D.D.T.

The Cabbage Borer (*Hellula Undalis*)—The insect has a world-wide distribution. The caterpillar, in early stages mines the foliage and feeds on the shoots. Finally it bores through the head. The larvae 2/3 inch long has a pale whitish brown colour with 3 or 4 longitudinal stripes.

Aphis The attack appears when there is cloudy weather on all the three, cabbage, cauliflower and knolkhol. The aphis also attacks the radish. The insect sucks up the juice and retards the normal growth. Nicotine sulphate is a very effective insecticide for the pest though rarely used. The insects are controlled in nature by lady bird beetles.

MUSTARD

Sinapis. Cruciferæ Family.

(*Hindi,* Rayee: *Singhalese,* Aba; *Kanarese,* Sasuve; *Telugu,* Avalu or Sasavalu; *Tamil,* Kadugu; *Malayalam,* Katuku.)

Annual. Native of Europe and Western Asia.

The cultivation of the Mustard is very simple. It thrives best in a rich, moist soil but can be grown in almost any soil. Sow seeds broadcast or in drills about a foot apart, putting the seeds rather close together. Where only a small quantity is required, shallow boxes or pots, containing very rich, friable soil, may be used. It is a very quick-growing plant, and can be cut within a few days of sowing. Sow seeds every 8 or 10 days to keep up a succession.

On the plains, the Mustard can be sown the year round. On the hills, sow from March to September. In very hot weather, sow under shade of trees, etc., to ensure a quick growth. The leaves, for use as salad should be cut when young. When they grow old or the plants begin to flower, the leaves become too strong-flavoured. In no case should the plants be allowed to run to seed. Big leaves are used as "greens," like Spinach. An ounce of seed will sow 100 feet of row.

The White Mustard (*Sinapis alba*) is generally grown for salad and greens and the Black Mustard (*Brassica nigra*) is grown for its seed which when ground forms the mustard of commerce or grocer's mustard.

We give below an American method of preparing and eating Mustard, which we trust will interest our readers:—

"To best appreciate Mustard as a salad, prepare it as follows:—Gather within a few minutes of meal times; wash if necessary, using plenty of water, in a deep pan. Shake out all water possible; throw upon a towel to quickly remove still more of the water; serve at once. Eaten just as they are, with salt, bread, and butter, is perhaps the best way to enjoy all piquant salads. But since many people like salad dressings, make such for two persons as follows:—Place half a tea-spoonful of salt, a pinch of white pepper, and

three table-spoonsful of the best olive oil in a saucer or bowl, and stir, adding *drop by drop* a tea-spoonful of lemon juice or vinegar, the former preferred. When thoroughly mixed, pour over the salad, mix up well and serve *at once.* Time, a couple of minutes. Do not use too much seasoning.

"For the benefit of those who have not used Mustard greens, the following recipe is given; it will be found general enough for all greens. Have the greens fresh from the garden and cleaned thoroughly. Have a large kettle filled with boiling water, to which add about one tea-spoonful of salt for each gallon of water. When the water boils violently, add the greens and keep the water at a galloping boil for six to ten minutes, according to the texture of the greens used, tender ones a shorter time than tough ones. Since covering the kettle holds in the steam and this dulls the colour, keep the lid off and push down the greens as they rise. Turn the cooked greens into a colander or a pan, the first preferred, and wash thoroughly and quickly in cold water. This will help to restore the brilliancy of colour. Drain well, pressing out all the water possible. Cut or chop fine and season well with salt and pepper. Reheat in a little butter, olive oil, or cream sauce and serve."

(*For Pests and Diseases, see page 114.*)

RADISH

Raphanus sativus. Cruciferæ Family.

(*Hindi,* Moolee; *Singhalese,* Rabu; *Kanarese,* Moolangi; *Telugu,* Moolangi; *Tamil,* Moolangi.)

Native of China and Southern India. Annual.

The writings of ancient naturalists indicate that this vegetable has been cultivated for a long time. Pliny records that it was extensively cultivated in Egypt at the time of the Pharaohs. The Greeks were especially fond of radishes and in their sacrificial offerings to Apollo, they were always served on dishes of gold. The radish was introduced into England and France about the beginning of the sixteenth century.

It is cultivated for its fleshy roots which are generally eaten raw when young. It thrives best in a light, rich, highly manured soil, and should be sown at frequent intervals to keep up a succession. The round and oval-rooted sorts are very quick in maturing, taking not more than 3 weeks to be ready for pulling in favourable conditions. The long-rooted kinds require a deeper soil and a little longer time to mature.

The radish is a cool weather plant and the quick growing, small rooted varieties will not produce tender roots if grown in hot weather. The long, large, acclimatised varieties, so extensively grown all over India, are hardier and can stand heat and rains much better.

Prepare the ground thoroughly, mixing it freely with well-decayed manure, taking care not to use fresh manure, and breaking up all lumpy manure and soil clods. A good dressing of nitrate of soda will greatly stimulate growth and insure tender, brittle roots. The seeds may either be sown broadcast or in drills. If broadcasted, use about a hundred seeds to every square foot of ground. The seeds may be covered about half an inch deep and soil firmed by pressing it down either with a board or by the back of a

spade. If in drills, let the drills stand about a foot apart. If the seeds come up too thick, thin out the plants so that they stand at a distance of about 3 to 4 inches apart. As they take up but little room and grow very quickly, they could be grown as a secondary crop, between rows of Beets, Knol Khols, Cabbages and other rather late-growing crops.

On the plains, sow from the beginning of the rains to the end of January where rainfall is light, but where heavy, sow when the rainy season is nearly over. In N. India and in other places where the months of June to August are very hot, the English radishes are best sown from the middle of August onwards. On the hills, from March to August. The acclimatised long white variety so extensively grown all over India is hardier, and can be sown much earlier as it stands rains better than other varieties. An ounce of seed will sow a row about 100 feet long; and 8 to 10 pounds will sow an acre.

Rat-tailed Radish—*Raphanus caudatus*—Also known as Mogri or Sengri. The edible part of this radish is not the root but the silique or seed-vessel, which is gathered before it is fully grown. The pods are usually deep violet coloured and reach a length of over two feet. They are eaten either raw or cooked; or they may be pickled in vinegar. Its cultivation is similar to the ordinary radish. On the plains the seeds may be put down any time from the middle of the rainy season till December, and on the hills from March to August. As the plants need more room to develop, they must be thinned out to stand about 18 inches apart each way.

(*For Pests and Diseases, see pages 114-115.*)

TURNIP

Brassica Rapa. *Cruciferæ* Family.

(*Hindi,* Shaljam or Sagalam; *Tamil.* Turnaps.)

Biennial. Native country uncertain.

The Turnip is a very easy crop to grow, the simplest management produces an ample supply. It is usually grown for its roots which are eaten cooked but there are some varieties, like the Japanese Shogoin, which are primarily grown for their tops (greens).

Any fairly good garden soil will grow good Turnips. To get the best flavoured Turnips, grow quickly in a rich, rather moist, light, sandy soil, which has been well worked.

The seed is sown either broadcast or in drills. The former practice is generally followed on light, sandy soil, the seeds being covered about half an inch deep with fine soil, using about three pounds of seed to the acre. To ensure even distribution of seeds, when sowing broadcast, it is a good plan to mix the seeds with about three or four times their bulk of fine sand or soil, before sowing. When the seedlings come up, they should be thinned out to a distance of about 6 to 9 inches apart. When sown in drills, they should be from 15 to 18 inches apart and thinned out to the usual distance. On heavy, tenacious soils, it is better to sow in regular rows or on ridges than broadcast. Sow at intervals of a fortnight each, to keep up a longer supply.

On the plains, sow from September to November, even earlier—say in June-July—in places where rainfall is moderate and the weather not hot. In the Punjab and other places where the weather is generally hot, it is better to sow the acclimatised varieties from July to September and the imported varieties from September to end of November. On the hills, from March to June and also in Autumn. One ounce of seed will sow a row about 150 feet long. Two to three pounds are required to sow an acre. The early varieties of Turnips are best gathered before they have fully grown, when they are still tender. They take from 6 to 8 weeks to be ready for the table from the time of sowing. The average yield per acre is about 10 tons.

RUTABAGA, SWEDE, OR RUSSIAN TURNIP.

As already explained under the heading of Cabbage, this is not really a Turnip but a Cabbage with a root like the Turnip, growing partly underground. Cultivation is similar to the Turnip except that the Swede is larger, and requires much more room to grow. It takes about three months to be ready. The average yield per acre is about 12 tons.

(*For Pests and Diseases, see page 114.*)

CUCURBITACEÆ FAMILY

CUCUMBER

Cucumis sativus. Cucurbitaceæ Family.

(*Hindi*, Kheera; *Singhalese*, Rata-kakri; *Kanarese*, Southekayi; *Telugu*, Dosa Kaya: *Tamil*, Kakrikayi, Vellereekai; *Malayalam*, Kakarika.)

Native of the East Indies. Annual. It belongs to the same genus as the Melon. It is one of the oldest vegetables and was known to the ancient Greeks and Romans by whom it was introduced into Europe. It is a plant of easy culture, several varieties of it are grown largely in every part of the country. It will grow in any ordinary good garden soil, with a fair amount of manure added to it. The best soil for it is a warm, rich, sandy loam. Like the Melon, Cucumber is also a monœcious plant, having the stamens and pistils (male and female organs) in separate flowers on the same plant, and the intervention of insects or of man seems to be necessary to fertilise them. Sometimes the plants do not set fruits and the flowers die without producing fruits. In such cases the plants should be helped to set fruits by artificial pollination as suggested for Musk Melons.

Sometimes young plants are attacked by beetles. As a protection, dust the seedlings with fine tobacco dust as soon as they come up. Air-slaked lime mixed with ashes is also effective, but should be carefully used, for if too strong, it will injure the plants. This application should be repeated every few days in localities infested with the beetle.

The Cucumber is an annual of climbing habit, producing a fruit of well-known use when in an immature state. On the plains, sow seeds from March to July or even later in warm, moist districts, and again from October to December. On the hills, from March to June. Sow the seeds in hills (holes), at a distance of about four feet apart each way, putting an extra shovelful of well-rotted manure in each hill. Plant 8 to 10 seeds in each hill and when the plants are well up, allow only three of the best to remain and

[**For insect pests and diseases of Cucumber and allied plants, see pp. 126-130.**]

pull out the rest. Or the seeds may be sown 6 inches apart in a single or double line, in rows or sets of rows 5 feet asunder, and the rows staked up like peas when the plants are about 6 inches high. Early or hot weather sowings will need to be watered regularly every third or fourth day, but the rainy weather sowings will not need much attention. An ounce contains about 800 to 1,000 seeds; 2 to 3 pounds of seeds are required to sow an acre. They take about 50 to 70 days to be ready. 5,000 lbs. may be taken as an average yield per acre under ordinary field culture, though under favourable conditions, three to four times this yield is not uncommon.

DILPASAND (Tinda, Tensi, Denshi.)

Citrullus vulgaris fistulosus. *Cucurbitaceæ* Family.

This vegetable is generally cultivated in Gujarat, Sind and in many parts of N. India but seldom in other parts. In its edible stage, the Dilpasand is a globular, smooth gourd, the size of a fist or a little larger, having short, stiff hairs and weighing about 8-12 ozs. It is a sub-variety of the Water Melon.

It is sown at about the same time as other gourds—say from May to July—on the plains. It is seldom grown on the hills. It needs a light, sandy and well-manured soil. Stiff, clayey soil is unsuited to it.

The seeds are usually sown in prepared holes about 3-4 feet apart each way, putting down 3-4 seeds to each hole, but allowing only one plant to remain if all seeds come up. The vines may be supported on a rough trellis, though the common practice is to allow the plants to run over the ground.

BITTER GOURD (Balsam Pear.)

Momordica charantia. *Cucurbitaceæ* Family.

(*Hindi*, Karela; *Singhalese*, Karawila; *Kanarese*, Hagalkayi; *Telugu*, Kakara; *Tamil*, Parikkai or Pavakkai; *Malayalam*, Kappakka.)

This is an annual plant of slender climbing or trailing habit, extensively grown all over the country for the sake of its fruits, which, however, have a bitter taste. The fruits are from 4 to 8 inches long, thick in the centre, pointed at both ends, and covered with numerous little, blunt tubercles. They are green when unripe but turn to a beautiful orange-yellow when ripe. The seeds are flat and immersed in a red pulp.

The seeds may be sown from March to July and the plants either allowed to run over the ground or supported by a light trellis. Treatment is more or less similar to the Sponge Gourd. On hills of medium elevations, sow from April to June. Not grown above 5000 ft.

In Europe and America, it is occasionally grown in the flower garden as an ornamental creeper for the beauty of its small foliage, bright yellow flowers and curious fruits.

BOTTLE GOURD or DOODHEE

Lagenaria vulgaris. *Cucurbitaceæ* Family.

(*Hindi*, Al-Kaddu or Lauki; *Singhalese*, Diyalabu; *Kanarese*, Sorekayi; *Telugu*, Anuga Kaya or Sora Kaya; *Tamil*, Chorakkai; *Malayalam*, Chorakka.)

This is one of the commonest and most extensively grown of Indian

For diseases and pests of Gourds, see pages 127-129.

vegetables. On the plains, sow from February to August, and on the hills from beginning of April to end of May; choose a warm, sunny position.

This is a quick-growing annual plant of climbing or trailing habit. The fruit, when about half or three-quarters grown, supplies a fairly good vegetable. It is usually large and heavy and greatly varies in size and shape, is of a whitish-green colour, and contains a large percentage of watery matter. The commonest variety has a bottle-shaped fruit; other varieties have flat, globular, ovoid and long fruits, the last sometimes measuring three feet or more.

It will grow in any good soil, but prefers a heavily manured sandy loam. It is best to sow seeds where they are to grow, in prepared holes about 5 to 6 feet apart, putting down 3 – 4 seeds in each hole. Retain only one strong plant in each hole, pulling out the others. It needs copious watering in dry weather. The vines soon cover the ground and may be trained over any support. The plant produces large, pretty, mildly fragrant, white flowers followed by fruits. The Indian villager usually trains the vines over his hut. It is not essential to train them in the summer, when they may be allowed to run over the ground; but rainy season sowings are best trained over some support.

If the fruit is allowed to mature on the vines, it becomes woody, when it is hollowed and used as a bowl by mendicants. Other types of the fruit when dry are used as floats by fishermen.

SNAKE GOURD

Trichosanthes anguina. *Cucurbitaceæ* Family.

(*Hindi*, Chichinda or Padwal; *Singhalese*, Patola; *Kanarese*, Padwalkayi; *Telugu*, Potla Kaya; *Tamil*, Podahlankai; *Malayalam*, Podavalanga.)

This is a large, greenish-white, club-formed gourd, often attaining a length of from 3 to 5 feet and about 2-3 inches thick. There is also a variety of much shorter fruits—about 1-1½ ft. long.

The seeds are generally sown from April to July both on the plains and on hills of moderate elevations. Not grown above 5000 feet.

It is an annual plant of exceedingly rapid growth and of climbing habit. Any good garden soil, which is well-manured, will suit it. The seeds may be put down in rows 5-6 feet apart, in specially prepared holes, putting 4 or 5 seeds in each hole. If two sowings are made – one in April or May and another after the rains have commenced – a long succession can be maintained.

The fruits being long and thin, if not given the facility to grow straight, will be mis-shapen. The usual practice is to grow this vegetable on a specially built structure, which though of a temporary nature, adds beauty and novelty to the kitchen garden. This structure is somewhat similar to the betel-houses of Central India, but having less shade. It is built by firmly inserting posts about 5-6 feet in length, in rows about the same distance apart and with nearly the same length between the posts. To the tops of the posts transverse rods are fastened, and the climbing gourds are trained to the uprights and across the transverse rods until the whole is covered by a leafy screen and the fruits hang down beneath.

For Diseases and pests of Gourds, see pp. 127-129.

The above kind of arrangement can also be made for other kinds of gourds, such as Dilpasand, Turai, etc., though these latter do not need it as much as the Padwal.

SPONGE GOURD

Luffa acutangula. *Cucurbitaceæ* Family.

(*Hindi*, Tori, Kali Tori or Jhinga; *Singhalese*, Vetakolu; *Telugu*, Bira Kaya; *Tamil*, Peerkankai; *Malayalam*, Peechangha.)

Also known as Ridge Gourd.—Another Indian vegetable, commonly grown all over the country. It is an annual of climbing or trailing habit and is grown for its fruit which, when tender, is considered a good vegetable when properly dressed. It is about a foot long when fully grown. It is club shaped and is sharply ribbed from end to end, and of a dark green colour.

It grows well in all sorts of soils, but, like all other plants, responds to good treatment. The seeds are generally sown from March to July in well enriched soil. Hot weather sowings are made in patches at three feet apart each way, and the plants allowed to trail over the ground without support. Later or the rains sowings are made in rows 5 to 6 feet apart, allowing a space of 6-8 inches between each seed, and the vines supported on a rough trellis.

It can be grown on hill stations of low elevations up to say 3,500 feet or so, sown at the same time as on the plains. Seldom grown on higher elevations.

WHITE GOURD or WAX GOURD

Benincasa cerifera. *Cucurbitaceæ* Family.

(*Hindi*, Petha, Kumhra or Pani Kumhra; *Tamil*, Kalyana Pusineekai; *Malayalam*, Elavan.)

Native of India and China.

This is an extensive creeper of an annual habit, producing large pumpkin-like fruits, weighing about five pounds or more each, covered with a bluish-white waxy bloom. It is generally used for making sweet meats and pickles. When not fully grown, it can be used like other gourds in making vegetable curries, etc.

On the plains, seeds are generally sown from May to July. It is seldom grown on hill stations of high elevations. The plants thrive best in a light, sandy, but well-manured soil. The seeds are sown in prepared holes about 5 feet apart each way, putting 3-4 seeds in each hole and if all seeds come up, only one plant—the strongest looking—is allowed to remain, the rest being pulled out. The plants soon cover the ground and may be supported on a rough trellis or allowed to ramble over the roofs of thatched huts as is the common practice in many parts of India.

GHEE TURAI or LUFFA

Luffa ægyptica. *Cucurbitaceæ* Family.

(*Hindi*, Ghiya Torai or Dhandhal; *Singhalese*, Niyanvetakolu.)

This plant is also an annual of the same climbing or trailing habit as the Sponge Gourd but with a smooth, cylindrical fruit, about a foot long. The plant is ornamental, as it produces numerous, large, bright golden-yellow flowers.

For Diseases and pests of Gourds, see pages 127-128-129.

The fruits when ripe, form inside a tough fibrous mass which, when the seeds and shell are removed, is used for bathing purposes, and for scouring cooking utensils. The best luffahs are obtained in a cool climate.

MUSK MELON

Cucumis Melo. *Cucurbitaceæ* Family.

(*Hindi,* Kherbooza, Sakker Teti; *Kanarese,* Karbooja; *Telugu,* Kharbuja; *Tamil,* Mellam Pazham.)

A native of Central Asia. Annual. This plant has been in cultivation from time immemorial, and is extensively grown in tropical countries.

In the southern part of the U. S. A., where the tropical nature of the country allows the Melon and Water Melon to be easily grown, this deservedly popular fruit is very extensively grown, and thousands of acres are devoted every year to its cultivation. The world is indebted to American growers and hybridizers who have introduced many noteworthy varieties and have improved them greatly, giving more sweetness and flavour to the fruits, making the skin thinner, and the edible portion thicker, and in fixing these and other desirable qualities. Until the fruits are actually tried, one cannot realise to what extent the modern plant breeder has transformed them. The Americans usually call the musk melons *Cantaloupes,* a name of Italian origin.

Melons can be easily grown in light, sandy soil, heavily manured, the best soil being that of a dry river bed. If a sandy soil is not available, they can be grown with a little trouble, in any ordinary garden soil, by preparing it very thoroughly, and mixing it with a large quantity of manure containing straw and leaf mould, with an addition of fine sand if the soil is inclined to be heavy. It is an annual plant of trailing habit.

The melon is a monœcious plant; that is, male and female flowers, distinct from each other, are produced on the same plant. Insects, bees, etc., usually visit the flowers in great numbers, and are generally effectual in ensuring their fertilisation. But sometimes the plants do not set fruit; the flowers open and die without setting fruits. In such cases, it is better to fertilise the flowers artificially, by applying the pollen (yellowish powdery substance of the male flower) with a camel-hair brush to the stigma of the female flower. The female flower is situated on the top of the ovary which is ovoid at the time when the flower expands, and is generally as big as a betel-nut or even larger.

On the plains of N. India, sow from middle of January to middle of March, and on the hills from April to the end of May. In other places on the plains, where the winters are very mild, as in the Deccan, Bangalore, etc., seeds may be sown from September onwards. Prepare holes five or six feet apart each way, a foot deep and a foot or more wide, in which an additional shovelful of manure is added and thoroughly mixed with the prepared soil. The holes (or "hills" as they are generally called, as after the seeds are sown and covered with soil and the plants grow, the soil rises a

For insect pests of Melons, see pages 126,127.

little above the surrounding surface) should be only half filled, then put about 5 or 6 seeds in each, covering them with about an inch of soil. When the plants come up and begin to grow, more soil and manure should be put in, so that the stems of the growing plants are covered, and the holes are entirely filled up. Thus the roots of the plants are about three-quarters to a foot deep from the surface when the plants are fully grown. When growing on a larger scale, straight furrows may be made by a plough, about 9 inches deep, and at a distance of about 5 or 6 feet, and the seeds put in the bottom of the furrow dropping 5 or 6 seeds every six feet apart, covering them about an inch deep. As the plants grow, soil should be drawn towards the stems, so as to completely fill up the furrows. Thus the roots of the plants will be deep into the soil where they can be cool and can draw all the moisture they want.

When the plants have come up and have made some growth, thin them out, leaving only 2 of the healthiest plants to each hill. Keep the soil about the young vines, as well as the soil between the hills, constantly loose and fine by frequent workings. Water freely and copiously whenever needed in the first stages of the plants' growth. After the fruits are about half formed, the quantity of water given should be reduced, as too much water at this time is detrimental to the flavour of the fruit. Many fruits should not be allowed to set on one plant, and only a few selected ones allowed to mature. If the growing point of the plant is stopped by pinching it off when the plant has made a few leaves, it will throw out side-shoots and become bushy; then the side-shoots will each produce one or two fruits, but only one fruit should be allowed to each side-shoot. This system of pruning is not always necessary as many plants will naturally branch out early.

Cucumbers and Melons should not be grown near to each other, as they belong to the same plant family and adversely affect the fruits of each other.

It is not always easy to know when melons are ready to be picked from the vines. As the fruits start to ripen, the stem joining the fruit to the vine cracks away slightly from the fruit, and a small drop or two of reddish juice frequently appears around the edges of this crack. This is a sign that the fruit is almost ripe, and may be removed from the plant. Another sign of ripeness is that the fruit comes off readily, and is easily separated from the stem by a slight twist. If it adheres firmly, the fruit is not sufficiently ripe to pick. There are other indications of ripeness also, such as the changing colour of the skin or the development of the netting on the skin of the fruit in some varieties and the fragrance which the fruits emit when they reach maturity. It is interesting to note that the melons invariably seperate themselves from the plant at maturity, a characteristic of, perhaps, no other garden vegetable.

An ounce of seed will sow about 60 hills, and about 2 pounds will sow an acre. The early varieties take about 80 to 90 days to be ready. The late, large-fruiting varieties of the Casaba or Winter melon type, take from 2 to 3 weeks more to mature. The average yield per acre is about 5000-7000 pounds.

For insect pests of Melons, see pages 126, 127.

WATER MELON

Citrullus vulgaris. *Cucurbitaceæ* Family.

(*Hindi,* Tarbooza or Kalinda; *Kanarese,* Kalangadi; *Telugu,* Kallangadi or Daraboja; *Tamil,* Thanni-Mathan; *Malayalam,* Thanni-Mathan.)

A native of Africa. Annual.

The Water Melon vine makes quite a strong growth, and must have ample room in which to grow and spread.

Cultivation is very similar to the Musk Melon, the same season of growing and the same kind of soil are needed, but the seeds are planted at much greater distances than Musk Melon, giving them at least about 50 per cent. more space. After the plants have made some growth, they should be thinned out, leaving only one healthy plant to each hill. When the fruits appear, not more than one or two should be allowed to mature on each plant if large fruits are required; the rest should be carefully removed as soon as set. If the vines do not set fruit, hand-fertilise them as recommended in the case of the Musk Melon. If the growing fruits be protected by a covering of leaves, they will not get sun-burnt, as they sometimes do.

It is rather difficult to determine when to pick the fruits as they ripen The method is different from that of Musk Melons. One of the best indications of ripening is in the small tendril, where the stem of the fruit is attached to the vine; while the fruit is still growing, this small tendril remains fresh and green, but as the fruit ripens, it turns brown and dies, giving a good indication as to the ripening of the melon. Another good sign of ripening is that the white or uncoloured portion of the skin, where the fruit is in contact with the ground, takes on a creamy or yellowish tinge; this is not a very desirable guide, however, as the fruit has to be turned over to be examined. Experienced growers go chiefly by the sound the fruit produces when struck sharply with the fingers; the green fruit sounds solid while the ripe one gives a slightly hollow sound. Another test is to place the hand on the top of the fruit and to lean considerable weight on it; if ripe or nearly ripe, the Melon will "give" slightly under this pressure, and if quite ripe the flesh may be heard to crack slightly. In hot weather, the fruits should be cut from the vines as soon as ripe and placed in a cool, dark room for a day or two, as they become sweeter if treated in this way. The average yield per acre is at least 7,000 lbs. (*See page 126 for diseases.*)

PUMPKIN

Cucurbita maxima. *Cucurbitaceæ* Family.

(*Hindi,* Kuddoo; *Singhalese,* Wataka or Ratalabu; *Kanarese,* Kumbalakayi *Telugu,* Gummadi-kaya; *Tamil,* Pushni-kai; *Malayalam,* Mathan.)

This is an annual of climbing or trailing habit, and is supposed to be a native of tropical America. It is extensively cultivated throughout India for its fruit, which when cooked and dressed, both in an immature and ripe state, is much esteemed as a vegetable, while some varieties are made into a sweetmeat or preserve. It is also used for feeding cattle in Europe and America. The fruit which is usually of a very large size when mature, keeps for months.

The cultivation of the Pumpkin is very easy, especially if a rich, light, well-manured soil is available. As the plants grow quickly and take up a lot of ground, they should be allowed enough room and the seeds should be sown at a distance of eight or ten feet apart in hills or holes, specially prepared for them, putting 3 or 4 seeds to each hill. Prepare the holes, which may be about 16 to 20 inches deep and as much wide, putting a large layer of rich manure, and covering it with soil or compost, 6 to 8 inches thick. Sow seeds on this top soil covering them about an inch deep. As soon as they come up, sprinkle them with air-slaked lime or land plaster, mixed with dry garden soil or preferably with ashes. Fine tobacco dust can also be used for the same purpose with advantage. This will prevent the ravages of beetles to which this plant is susceptible in many localities.

When the plants have made some growth, thin them out to about 2 plants to each hill, allowing the healthiest plants to stand. Generally, the vines are allowed to run on the ground, but sometimes they are trained over strong trellises or are allowed to run over the roofs of out-houses, etc. If the flowers die away and fail to set fruits, use artificial hand-pollination as advised for musk melons. When the fruits grow, dry straw may be put underneath them, to prevent them from coming into direct contact with wet soil. They require a lot of water when growing, and it should be freely given whenever required. If large fruits are desired, allow only one, or at most two fruits to each plant. When the fruits are ripe, they should be carefully detached from the vines, allowing a small piece of stem attached to the fruits, which should not be bruised. When kept in a dry, rather warm place, they keep well for months.

On the plains, sow from February to July, and on the hills, from March to June. An ounce of seed will sow from 30 to 50 hills; and about 2 to 4 pounds according to variety, are required to sow an acre. They take about 90 to 120 days to get ready. The average yield per acre is about 8 to 10 tons.

The Pumpkin differs very little from the Squash or Vegetable Marrow, especially what are known as Winter Squashes. The introduction, in recent times, of some improved varieties of the Squash has greatly decreased the cultivation of the Pumpkin in the ordinary home garden. It is not a good plan to grow different plants of the Cucurbitaceæ family side by side in the same field, as they are sure to affect each other and deteriorate the quality of the fruits.

How to grow prize Pumpkins—Select a rich piece of ground, make a hole in it, say about 3 to 4 feet across each way, and about a foot or more deep. Fill it up with manure and cover with soil. In the centre of this hole, sink a bottomless keg or bucket for applying water. Plant the seed in small hills around this large central hill of manure, and about one foot away, so that the young plants may secure a good start before the roots extend into the manure. They should be frequently hoed till well established, and should be thinned out to one in a place, leaving only about 4 to 6 plants around the central hill. Give frequent doses of liquid manure to promote stronger growth. When the young fruits are forming, select one or two of the best on each vine, and remove all the others, so as to throw the entire strength of the plant in the fruits left. If the vines grow too long, pinch them off a yard or more beyond the fruit. Squashes can also be grown similarly to obtain extra large fruits.

The diseases associated with the *Cucurbitaceæ* family are treated below. They apply to Cucumber, Melon, Water Melon, Pumpkin, Squash, (Vegetable Marrow), etc.

Downy mildew, Leaf spot, Anthracnose, Coltony leak, Qummosis and Mosaic.

The aggregate effect of the attack of these diseases, many times results in a total failure of the crop. The only remedial measure practised is the removal of affected plants. The only insecticide useful is Bordeaux Mixture against downy mildew.

The pests attacking these crops are all similar (*Epilachna spp*). Epilachna beetle is the chief pest among this class of crops. Control measures adopted under brinjal are to be adopted in this case also.

Leaf Caterpillar (*Margaronia indica, S*)—The caterpillar, an elongated bright green caterpillar with a pair of narrow longitudinal white streaks along the mid dorsal lines feeds on the foliage and pupates in a flimsy silken cocoon inside a leaf fold. The damage by the insect is about 5 to 20 per cent.

The Snake Gourd Semilooper (*Plusia peponis F*)—The caterpillar is more commonly found on snake gourds, is a semi-looper with whitish green elongated body. The damage is sometimes immense, the gourds being sometimes stripped of all leaves.

Hand picking of both the caterpillars is the method usually practised.

Red Pumpkin Beetle (*Aulacophora abdominalis*)—The most notorious pest of the Cucurbitaceous creepers. These are medium-sized, active creatures feeding on the foliage and causing considerable damage. They are found in red, blue and grey colours. Use of stomach poisons (lead arsenate 3 ozs. + jaggery 1 lb. and water 4 gallons) or repellant like kerosene has been found useful.

Fruit Flies (*Dacus and chætodacus*)—The maggots of these flies bore into the ripening fruits and often cause appreciable damage. The flies can be easily distinguished from ordinary flies by their triangular shaped abdomen and spotted wings. The damage sometimes is about 50 per cent. Control measures are preventive and consist of removal of affected fruits. Cucurbitaceous plants are damaged by D.D.T. and D.D.T. does not afford a possible control measure for the pests of this class of plants.

[Also see pages 127-130.]

SQUASH OR VEGETABLE MARROW

Cucurbita Pepo and C. maxima. *Cucurbitaceæ* Family.

(*Hindi*, Kumra; *Telugu*, Sima Gummadi Kaya.)

Native of tropical America. Annual.

These plants which are mostly of trailing habit, belong to the same plant family as the Pumpkin, and require the same treatment of culture and soil. They are very largely grown in America, and in some parts of Europe. Being tropical, they are easily grown in India, when treated as a summer vegetable.

They are generally divided into two classes: **Summer** and **Winter** Squash. The former are generally used when the fruits are immature and about three-quarters grown. They do not keep for any length of time. The latter are used only when they are fully matured, and are very good keepers; they resemble the Pumpkin in many ways. Some of the Summer Squashes are of the bush type—that is, the plants are not trailing but grow compact. These are grown in hills which may be only about 4 feet apart each way, whereas the other varieties of the Summer Squash which are trailing require at least double the room. The Winter Squashes are mostly of the trailing habit. They also produce fruits with a hard shell or rind, and solid, richly-coloured flesh. They are used for stewing or making pies, like Pumpkins.

It sometimes happens that apparently healthy plants produce fruits which when very small wither away and die for apparently no reason. The cause is the same as in the case of melons—the plant bears both male and female flowers separately, the latter only bear the fruits. When the female flowers are not pollinated by natural agencies such as bees and other insects, the fruits cannot develop. Hand fertilization, as suggested for the musk melon, will remedy the defect.

The Summer Squashes being soft-skinned, do not keep long and should be gathered before they are fully matured, and while they are still young and tender. The proper time for gathering the fruits after they have reached good size, is easily ascertained by puncturing the skin of the fruit with the thumb nail. If the skin is too hard to puncture easily, the fruit is too old and should be discarded, and at once removed from the plant, so as to encourage the plant to produce other fruits.

The time of planting, and the quantity of seed required are about the same as for the Pumpkin. But in places where the cold weather is very mild, as in Lower Bengal and some parts of Southern India, it can be sown also in October. But in the United Provinces and the Punjab, the plants will not stand the cold weather, and seeds should not be sown before February.

The same time of sowing is suited to both the Winter and Summer Squashes in our country. The plants and fruits being sensitive to cold, should not be exposed to frost. The Summer Squashes and early varieties, are ready to be picked within eight weeks from the time of sowing the seeds, and the late varieties of the Winter Squash take a much longer period to mature—about 3 to 4 months according to variety, climate and soil. The average yield per acre is about 8 tons.

(For Pests and Diseases, see page 126.)

(The following notes, taken from Bulletin No. 3 (Fruit Series), Department of Agriculture, U. P., entitled "The Damage Caused by Insects on some commonly grown Fruits in the Plains of the United Provinces", are reproduced by kind permission of the Government Entomologist, United Provinces, Cawnpore.)

INSECT PESTS
of Melons, Pumpkins, and other Gourds.

"The flowers are often eaten by adult beetles, particularly the red and black banded blister beetles. These are readily seen on the plant and can be collected and destroyed.

"The leaves of these crops are often heavily attacked by beetles, both adult and larvæ. The most important of these is the red pumpkin beetle. Others which sometimes cause serious damage are the twelve spotted and the twenty-eight spotted lady-bird beetles.

"*The red pumpkin beetle (Aulacophora abdominalis)*—This is an orange-red beetle, about a quarter of an inch long. The adult beetles eat the leaves, particularly of young plants, and the damage may be so extensive that all the leaves are eaten and the plant dies. The eggs are laid in the soil and the larvæ live under ground, feeding on or inside the roots, or on the underside of leaves which are touching the ground. One generation is completed in about a month, and several broods are passed through in one season. The red pumpkin beetle is usually most plentiful from March to May. It changes from the larvæ to the adult in the soil; and in the cold weather the adults shelter in the soil or among old creepers.

"*Control*—The adult beetles may be caught in hand-nets and destroyed. They may be kept away from the plants by sprinkling the leaves with wood ashes or finely powdered silt to which kerosene oil has been added. They may be destroyed by spraying the plants with a stomach poison. It is not desirable to use an arsenic stomach poison if any fruits have set on the plants. For young plants lead arsenate paste one pound, freshly slaked lime two pounds, made up with ten gallons of water, may be used.

"For plants on which the fruits have developed, the infusion from one pound of country tobacco may be used in ten gallons of water to which two pounds of kerosene emulsion have been added.

"Ploughing and harrowing, after the crop has been taken, to expose the larvæ and pupæ to the sun and to birds; the removal of old creepers and weeds in which the adults can rest over winter; and the growing of early varieties which will be well established before the beetles become active in the spring, would greatly help to reduce the attack.

"*The twelve spotted and twenty-eight spotted lady-bird beetles (Epilachna spp)*—These beetles feed upon the leaves, both as adults and as larvæ. They can generally be controlled by hand collection on the leaves.

"*Fruit flies*—The pumpkin fly (*Chætodacus cucurbitæ*), and other fruit flies, attack the fruits of melons and gourds. The eggs are laid under the skin and the maggots burrow into the fruit.

"*Control*—The attacked fruits should be picked and destroyed by rotting in water or by boiling. This must be done before the maggots have matured and come out of the fruit to enter the soil to change into adult flies. It is particularly important to collect and destroy the attacked fruits early in the season, so as to prevent the multiplication of this serious pest.

"*Tobacco infusion*—An extract of country tobacco in water acts as a stomach poison, and the fumes which it gives off are also poisonous to insects. To prepare, crush up one pound of the coarsest country tobacco and steep it for twenty-four hours in one gallon of water. Pour this water into another vessel and steep again for twenty-four hours in a second gallon. Repeat this process again on the third day. There will then be three gallons of tobacco infusion. Add further water to make up to ten gallons

Tobacco infusion is made much more effective by the addition of one pound of soft (fish-oil) soap, or two pounds of kerosene emulsion, to every ten gallons.

"Tobacco infusion can be sprayed on to vegetables or fruits which are not ready for immediate consumption.

"*Tobacco mixture*—The addition of one pound of fish-oil soft soap to ten gallons makes the infusion more effective as it wets the small insects more thoroughly.

"A mixture of two pounds of kerosene emulsion to each ten gallons of the tobacco infusion is still more effective, especially for insects which have a waxy protection. This mixture acts as a combined contact and stomach poison.

"*Kerosene emulsion*—Kerosene oil (ordinary lamp oil) is a deadly poison to insects. It cannot be used undiluted as it injures foliage. It is therefore necessary to dilute it, so that the contact poison mixture contains about two parts of oil in one hundred parts of water, if young foliage is to be sprayed. As oil and water will not mix, the oil has first to be mixed with soap solution to form an emulsion.

"Ready made kerosene emulsion can be obtained from dealers in heavy chemicals. Commercial kerosene emulsion should contain between seventy and eighty-five parts of oil in a hundred. This may be used at the rate of one gallon to thirty or forty gallons of water for spraying young foliage and flowers of mangoes against the leaf-hoppers, and for other small insects having a waxy coat. On old leaves and on dormant trees a much greater strength may be safely used.

"Kerosene emulsion may be prepared from kerosene oil and soft soap. Dissolve one pound of soft soap in one gallon of water in a kerosene tin. Boil the mixture, take off the fire and, while still hot, add gradually two gallons of kerosene oil. The oil must be forced into the soap solution either through a syringe with a fine rose, or through the jet of a spraying machine. It cannot be mixed satisfactorily by stirring. A creamy mixture should result from which, when mixed with water, the oil does not separate out and float on the surface.

"Home-made kerosene emulsion may be used at a strength of one gallon in ten to thirty gallons of water. (*See also page 172.*)

"*Lime-sulphur wash*—This is a combination of white lime and finely powdered sulphur, which, when properly prepared, is the most effective poison for mites on plants.

"Lime-sulphur insecticide is not easy to prepare; and it is better to purchase the material ready made from dealers in heavy chemicals. The strength at which the commercial preparation should be used will be indicated by the sellers.

"Lime-sulphur may be prepared in the following way:

"Twenty seers (40 lb.) of good quick-lime is placed in a large iron vessel. The best white lime containing not more than five per cent. of magnesium oxide is necessary. It should be fresh-burnt lime, not more

than two days old, and in small pieces. Ten seers (20 lb.) of finely powdered sulphur are mixed with the lime. Sufficient water is then added to induce rapid slaking of the quick-lime, and the vessel is covered with a blanket to retain the heat. From time to time more water is added as required to maintain the slaking, and the mixture is occasionally stirred. When the slaking is complete, the mixture is allowed to stand for a while, and is then mixed with warm water to make up fifty gallons, and used at once." [For making a weaker solution, see page 171.]

GRAMINEÆ FAMILY

INDIAN CORN OR MAIZE

Zea mays. *Gramineæ* Family.

(*Hindi,* Mukka or Bhutta; *Kanarese,* Musuku Jola; *Telugu,* Mokka Jonnalu; *Tamil,* Chola-kondai, Mukka Cholam; *Malayalam,* Mukka Cholam, Chola Kondda.)

Native of America. Annual. The Maize is extensively cultivated as a cereal in all parts of India for its grain and also in the garden for its cobs, which when green and tender, are relished by many.

The Maize which is known in America as "Corn" is very extensively cultivated as one of the principal agricultural crops in the U. S. A., and many greatly improved and superior varieties have been introduced during the past few years.

The cultivation of the Maize is very simple. Any ordinary, good garden soil will grow it well. But the best soil is a well-enriched sandy loam. Sow the seeds in rows about 2 to 3 feet apart, putting them at a distance of about 3 to 4 inches in the rows. Cover the seeds about 1 to 2 inches deep, and press down firmly. For a continuous supply, sow in succession every other week. Thin out the plants to a distance of 6 to 9 inches apart, when they are a few inches high. It is a good plan to earth up the plants as they grow, first to a height of about 4 to 5 inches, then later, to about a foot. Water must be supplied plentifully and regularly, and no weeds allowed to grow. To enjoy fresh and tasty corn, one must raise it in one's own garden, as it is said that a few hours after the cobs are removed from the plants, they lose more than half their sweetness. The finest Sweet Corn must be picked in just the right condition, that is, when the skin of the grain breaks at the slightest puncture.

On the plains, sow from April to July, and during May and June on the hills. One pound of seed will sow a row from 300 to 500 feet long, and about 10 to 15 pounds are required to sow an acre. They take from 60 to 90 days to be ready. The average yield per acre is from 3,000 to 5,000 pounds of ears.

The Sweet or Sugar Corns are exceptionally rich in sugar, and are greatly prized wherever grown. The Field Corns are hardier and possess a little less sugar. The Pop Corns are also greatly grown in America. The kernels when brought near heat, pop or turn inside out, become pure white and are very much relished by some people.

Why Pop Corn Pops

Moisture stored in the kernels of Pop Corn is converted into steam when the Corn is heated, and it is the pressure of this steam which causes Pop Corn to pop. Corn will not pop well if it contains too little or too much moisture.

Pop Corn stored where it is in contact with the outside air usually will have the right amount of moisture for popping. If it is too moist, exposure in a heated room or in the sun will dry it out. If it is too dry, sprinkle it with water and leave it in a tight container for a day or two, until the moisture is absorbed. Corn pops best when the fire is hot enough to make it begin to pop in about one and a half minutes.

LEGUMINOSEÆ FAMILY

BROAD BEANS

Faba vulgaris; Vicia faba. *Leguminoseæ* Family.

(*Hindi*, Bakla Sem; *Kanarese*, Avare Kayi; *Telugu*, Ulu-kayi; *Tamil*, Seemay Avarakai; *Malayalam*, Avarakka.)

Originally found in the East, probably in Iran. Annual. This plant has been cultivated for many centuries, its large size and the alimentary properties of its seeds having drawn attention to it.

It is an erect growing plant, thriving best in a heavy or clayey, though rich soil. It will also thrive on a deep, sandy loam which, it may be noted, is good for almost any vegetable.

There are two classes of Broad Beans—the Broad Windsor and the Longpod. The former is rather difficult to grow in India, though it does very well on hill stations. The latter seems to be more adaptable and can be grown almost everywhere.

Sow the seeds about two inches deep, in rows of double drills one foot apart, with a space of three feet between each row of double drills. The seeds may stand about 4 to 6 inches apart in the drills. Sometimes, seeds may not come up well, especially in dry soils. It is then advisable to soak them for a few hours in warm water before planting, though this is not always essential. When the plants begin to flower, nipping off the tops will induce the plants to set freely and will also prevent them from being attacked by aphides.

In places exposed to heavy winds, it is better to support the plants by sticks. The seeds or beans are eaten boiled, both in the green and in the dried states.

In Northern India, sow from middle of October to end of November; not earlier, as the young plants cannot stand the heat well. In other places, sowings may be made about 6 to 8 weeks earlier. On the hills, sow from March to the end of May; also in Autumn. A pound of seed will sow a row of about 30 to 50 feet long. They take about 3 months to be ready. If the beans are wanted for a longer period, make two or three sowings at intervals of about 20 days.

FRENCH OR KIDNEY BEANS

Phaceolus vulgaris. *Leguminoseæ* Family.

(*Hindi,* Chota Sem, Vilaiti Sem; *Singhalese,* Bonchi; *Kanarese,* Hurli Kai; *Telugu,* Potti-Chikkudu; *Tamil,* Kollukai; *Malayalam,* Avarakka.)

Native of South America. Annual. These are divided into two main classes—Climbing and Dwarf or Bush. The former are more prolific and have a longer season, though not quite so easily grown as the latter.

Dwarf Beans—During recent years, plant breeders have greatly improved the bean, producing varieties which contain a much greater proportion of flesh and are entirely free from strings or any fibre in the pod.

The Dwarf or Bush Bean, while responding to rich soil and thorough cultivation, will succeed well in almost any garden soil. Beans are very sensitive to both cold and wet and should not be sown in continuously wet and cold weather, or in cold or wet soil. (See remarks under the heading of "Peas, Beans and Maize" in part I p. 13.) A light shade of tall trees and protection from heavy winds is desirable. As they are ready within two months, it is advisable to sow them in succession at intervals of a fortnight each. On the plains, sow from middle of August to end of October or earlier—say in June-July—if the weather is not hot and the rains not too heavy, and in favourable localities even a little later than October, and on the hills from end of March to end of June. The ground should be well prepared and the seeds sown thinly in rows about 18 to 24 inches apart, letting the seeds drop at a distance of about 3 to 4 inches in the rows. One pound of seed will sow a row of about 50 to 60 feet or about 60 pounds of seed will sow an acre. As soon as the young plants appear, the soil should be stirred and cultivation should be kept up as frequently as possible during the entire season of growth. The gathering of pods should begin as soon as they are large enough for use—the half grown pods being the finest for table use. By picking the pods as fast as they are ready for use and keeping the soil well stirred, the plants will continue in bearing much longer than if allowed to ripen seed. The average yield per acre is about 1,500 pounds of dried beans.

Runner or Pole Beans—These require about the same treatment as above, except that they are planted in holes (or "hills" as they are called) instead of in rows. The season of growth and bearing is longer than that of the Dwarf beans. It is necessary to make the soil very rich if a very large crop is desired. For field plantings about twenty tons of stable manure per acre is needed. Use strong poles or bamboos about 1½ to 2 inches in diameter at the bottom and about 6 to 8 feet long. Insert them firmly in the ground, setting at a distance of about four feet apart each way. Then near the pole, sow about six seeds, covering them about two inches and when they come up and have made some growth, leave only three of the strongest plants, pulling out the others, and train them on the poles by help of small twigs or strings, remembering that the vines have a habit of twining from left to right. If economy in manure is to be made, then holes should be made where the poles are inserted, about 2 feet wide and as much deep and filled up with rich earth and manure, and the seeds sown in them.

Where poles are unavailable or undesirable, posts or stout stakes are set at each end of the row where the beans are to be planted and two wires—rather heavy—are then stretched over the supports at each end of the row, one about four inches from the ground and the other about six feet. Then, any kind of cheap but fairly strong twine is tied between the wires for the vines to run on. The strings may be spaced about 2 feet apart along the row and one plant allowed to grow on each string.

It is claimed by some that the beans require a certain kind of bacteria in the soil for their best development and that if the same ground be used year after year, the bacteria increase in numbers and the beans grow much better than if they are planted every year in fresh soil.

About two pounds of seeds are required for 100 hills. Or about 25 pounds are required to sow an acre. They take about 65 to 80 days to be ready after seeds are sown.

[For control of Bean and Pea Weevil, see page 137.]

SCARLET RUNNER BEANS

Phaceolus multiflorus. *Leguminoseœ* Family.

Hindi, Sem; *Kanarese*, Avare Kayi; *Telugu*, Ulu-kayi; *Tamil*, Seemay Avarakai; *Malayalam*, Avarakka.)

This is a perennial of climbing habit and a native of South America. It does well in Northern India and on hill stations, and produces very ornamental flowers followed by pods. Its rapid growth and ornamental character lend it admirably for growing it as a screen. It is grown in much the same manner as other Runner Beans, the seeds being sown at about the same time. If grown on poles, they may be inserted in the ground in threes and slanting towards one another at the top where they may be tied together, thus making a pyramid, or they may be grown on stakes a little stronger than those used for peas. They get ready in about 2 to 3 months after sowing.

The Scarlet Runner does not thrive on the plains of Southern India, where, however, the other varieties of Runner and Lima Beans do very well.

LIMA BEANS

Phaceolus lunatus. *Leguminoseœ* Family.

(*Singhalese*, Pithanga; *Kanarese*, Avare Kayi; *Telugu*, Ulu-kayi; *Tamil*, Seemay Avarakai; *Malayalam*, Avarakka.)

Native of South America. Annual. The Lima Bean is sometimes called Butter or Double Bean. It is grown in many parts of India and Burma, but is not cultivated as largely as it should be. In the warmer sections of the United States of America, it is grown very extensively on a commercial scale.

The tall growing varieties of Lima Beans are grown in the same manner as the ordinary Pole or Runner Beans, but take a little longer to mature. The seeds are used either green or dried, and have a very fine meaty flavour, and being farinaceous are highly esteemed wherever grown. There is also a dwarf or bush form of this Bean which requires no poles or strings and grows just like the Dwarf French or Kidney Beans. The Bush Limas are about two to three weeks earlier than Pole Limas, taking from 70 to 80 days to be ready. The average height of the Bush Limas

is about 18 inches. These may be sown in drills about 2 to 3 feet apart, dropping the beans (seeds), eyes downwards, about 4 to 5 inches apart, and covering them about 2 inches deep. They should not be planted in cold or wet ground as, in this case, they are likely to rot. The average yield per acre is about 1,900 lbs.

Those who are not familiar with the growth of the Bush Limas frequently mistake the long blossom shoots (which, early in the season, show above the foliage), for runners or vines, but if these shoots are carefully examined they will be found to terminate in a cluster of blossoms and entirely free from the twist or curl which appears in the shoots of the Pole Limas.

CUBA BEANS (Asparagus Beans.)

Dolichos sesquipedalis. *Leguminoseæ* Family.

(*Hindi*, Lobiya. *Gujrati*, Choli Sing.)

This is an annual climbing plant, native of South America, growing to a height of ten feet or more. It produces freely very long, round pods, of a light green colour, which if collected before they are fully matured, are used like Kidney or French Beans.

It is of easy culture, thriving in any ordinary garden soil. On the plains sow seeds 6 inches apart, in rows 4 to 5 feet apart, any time from April to July or even a little later, staking up the rows with sticks when the plants are a few inches high. Takes about 2½ to 3 months to be ready. On hill stations of high elevations, this plant is seldom grown.

VELVET BEANS

Macuna capitata. *Leguminoseæ* Family.

(*Hindi*, Khamach, Uda Sem, Tohar Sem; *Tamil*, Punaik-Kali; *Telugu*, Pilli-Adugu; *Bengali*, Alkushi and *Bombay*, Kuhili.)

This is an annual of twining habit, and is grown for the immature seed pods. The latter hang in clusters, are about 3 to 6 inches long, and are covered with a black velvet-like down which, on being rubbed off, discloses a smooth-skinned pod resembling a French bean, and not much inferior to the latter when cooked, provided it is gathered when young and tender.

The seeds may be sown in any ordinary garden soil, from April to June, 6 inches apart, in rows 5 or 6 feet apart, and the plants given some rough support to climb upon. In places with mild summers and winters, it can be grown over a longer period. It is seldom grown on the hills.

Like other leguminous plants, it is very valuable as a green manuring and forage plant. It adds nitrogen in the soil on which it is grown and thus greatly enriches it for the crops which follow.

PEAS

Pisum sativum. *Leguminoseæ* Family.

(*Hindi*, Mater; *Singhalese*, Bola-kadala; *Kanarese*, Battani; *Telugu*, Battani; *Tamil*, Pattani Kadalai.)

Native of Southern Europe or Western Asia. Annual.

The garden Pea prefers a cool, moist, loamy soil or even clayey soil, into which the roots can penetrate deeply; but good results can also be had,

especially with the dwarf-growing, early sorts, on light soils during the cool months, as these varieties produce pods ready for the table in about 60 to 70 days from planting. The dwarf, early varieties, growing only from 12 to 18 inches in height, are also especially desirable for the small home garden, as they do not require brush (twiggy branches of trees or of bamboos) or trellis to support them and the rows can be planted quite closely together. Where the conditions of soil and climate are favourable, however, the tall-growing, large-podded, late sorts are preferable, as they are much more productive and continue in bearing for a longer period of time. For the general garden, probably the most satisfactory procedure would be to combine some dwarf sorts for early use, and taller ones for a late supply.

The Garden Pea has received so much careful attention from enthusiastic specialists and plant breeders during the past ten or fifteen years, that we have now wrinkled as well as round-seeded Peas for the earliest supply. These have lost none of the true marrowfat flavour, while the size of both the pods and seeds is greatly increased without sacrificing flavour.

The Garden Pea is a cool-weather plant and does not grow well during the intense heat of summer. Usually the best results are obtained by early sowings, although they may be sown late—much depends on the intensity of the heat during the growing season. The soil should be ploughed or dug pretty deep, and tolerably well supplied with well-decayed stable manure, worked as low down as possible. A little quantity of lime added to the soil will improve it greatly. If a little bone-meal is mixed with the manure, at the rate of a pound for every four square yards, it will greatly benefit the crop. It must always be borne in mind that the deeper the rooting process, the greater the prospects of success. If the ground has been heavily manured for a previous crop, so much the better; then too much manure should not be used again. Two or three successive sowings at intervals of a fortnight each, ensure a longer supply.

Sow the dwarf-growing sorts in single rows about 12 to 18 inches apart, covering the seeds about 2 to 3 inches deep, if the soil is not too heavy. If heavy, cover the seeds less—about 1 to 1½ inches deep—sowing the seeds at the rate of 8 to 10 to the foot. The rows of the semi-dwarf and tall varieties, may be from two to four feet apart, according to the height of the variety grown and the strength of the soil. When grown on a large scale in the field, the vines are not supported but are allowed to run on the ground. In this case, the growing vines are pinched off at the top, just after the fifth or sixth flower, after which the vines become more bushy. But in the kitchen garden, all tall varieties should be supported by branches of trees or thin, light, well-branched bamboos, or some kind of trellis.

In the small home garden, where a neat and attractive effect is valued as much as the material produce of the garden, a very satisfactory trellis can be made by using stakes about two inches square, which are sharpened at one end and firmly set in or alongside the row, four feet apart, running with the row. To these stakes, light wire fencing with a two-inch mesh is attached with small staples, which make a most satisfactory support for the large, late Garden Peas, as well as for the more ornamental Sweet Peas, Climbing Nasturtiums, Morning Glories, etc., and also for Lima Beans. The Pea vine twists in and out of the woven meshes of the wire netting, and is also attached by the leaf tendrils, so that where the stakes are firmly set, there is no chance

of the vines being blown down. As this wire netting comes in different widths, a trellis of any needed height can be readily made. This support is quite durable and can be taken up after the Peas have finished bearing. It can be cleaned and rolled up, either by detaching the wire or leaving it fast to the stakes, and can be stored away for use next season.

The method of planting the Peas in double rows is practised by many, as one trellis can support two rows. In this case, the rows are about 9 inches apart for the dwarf sorts, leaving about 2 to 2½ feet between each of the double rows, and in the case of later varieties, the rows may be about a foot apart, leaving a space of four to five feet between each double row. The only after-attention the plants need is regular watering in dry weather, and cultivation of the soil to keep it free from all weeds. It is a good plan to draw the earth near the stems of the plants when they are about a foot high. Thus the roots will be deeper in the cool soil. In localities where the Pea does not thrive well, or where the season is not cool or long enough to allow the Pea to succeed, the following method may be tried with advantage. Peas, as a rule, do not like rank or fresh manure. A highly nitrogenous fertiliser should not be applied immediately before planting the seed, as it is liable to cause an excessive growth of leaves at the expense of pods. Select a plot which had been heavily manured for a previous crop. If this is not available, select the best plot in the garden you have. Make trenches either by a deep working plough or by digging at the right distance apart for putting down the seeds. The trenches may be about a foot and a half to two feet deep and a foot or more wide. Remove the soil from the trench and put it alongside. Then, loosen the soil at the bottom of the trench to a depth of about 6 to 8 inches. On top of this loosened soil, put a layer of 5 to 6 inches of well-rotted manure, and cover it with soil removed from the top, filling upto within 8 to 10 inches of the top. Then flood the trench with water. After two or three days, when the soil is still moist, but not too wet, sow the seeds in the centre of the trench on the top layer of the soil, covering them with about 2 to 3 inches of soil. Do not water immediately after, but only when the top layer has become dry. As the plants come up and grow, draw the soil near the stems, so that finally the whole trench is nearly filled up. All lumps of manure and clods of soil should be well broken up. If the soil is very heavy or clayey, it is better to mix it with some fine sand, leaf-mould or wood ashes. Plants thus grown will have their roots deep down in cool soil, will resist drought and heat better, and the manure at the bottom of the trench will always keep the roots attracted to it; thus there will be no roots near the surface to be adversely affected by the heat of the sun. Watering should be done plentifully and whenever required. As soon as the plants are a few inches high, stake them before they begin to fall. Keep the surface soil stirred frequently to a depth of 3 to 4 inches and dust the plants occasionally with flowers of sulphur (which can be obtained from any chemist), to prevent mildew to which the Pea is very susceptible in hot weather. This is best done in the morning. Another thing to observe is early sowing; this ensures the longest cool weather for the plants to grow.

Picking the pods should be commenced as soon as they are filled. No pods should be left on the plants to mature, otherwise the plants will not continue to bear more pods. While gathering the pods, great care should be taken not to injure the plants. It is better to use a pair of scissors for removing the pods from the vines.

Peas are divided and sub-divided into numerous sections according to the smoothness or roughness (wrinkled condition) of the peas when dried, according to their heights, earliness, and the edible or non-edible property of the entire pods. The latter are called Shelling Peas and the former Edible-podded or Sugar Peas. The Sugar Peas should be picked when the seeds are just forming, and cooked like ordinary kidney beans, and there are dozens of varieties of each.

As a rule, the round-seeded Peas are hardier, they retain their vitality longer, and germinate better than the wrinkled-seeded Peas. The latter, however, possess better flavour and contain more sugary matter. On account of the high percentage of sugary matter in the highly-bred modern Peas, they are very susceptible to cold and wet soils, and often fail to come up satisfactorily, if at all. (See further remarks on this subject in Part I, page 13 of the Guide, under the heading of "Peas, Beans and Maize.")

On the plains, where the rainfall is light—not over 20 or 25 inches annually, and where the climate is not hot during the rainy months (June, July, August and September)—the Peas could be put down from the middle of June to the end of November. In N. India, the best time is during October and November. On the hills, from March to May and also in Autumn. One pound of Peas will sow a row about 60 feet long. From 60 to 100 pounds are required to sow an acre. The average yield per acre is about 1,500 to 2,000 pounds of Peas.

As an article of food, Peas are very nutritious, rich in phosphates and alkalies, therefore the plant makes a heavy demand on the soil, constituting what is termed an exhaustive crop. For this reason, and also because it is a very early maturing crop, it is imperative that the land should be well prepared to enable the roots to ramify freely, and rapidly collect the food required by the plant. Unlike the beans, it should not be grown on the same land year after year, but a new site must be allotted to it every year or at least every two years.

The common diseases and pests are:—

Fusarium Wilt, Root Rot, Pea Blight, Powdery Mildew, Downy Mildew and Pea Mosaic are the common diseases. Sulphur dusting has been found useful with Powdery mildew and Bordeaux mixture spray with Downy mildew. In case of other diseases, the control measures consist of uprooting and burning the affected plants.

Pea aphis, pea weevil and pea leafminer are the three pests associated with the crop. The aphis not only does damage by sucking the cell sap but is again responsible for the spread of tomato mosaic. It should, therefore, be always destroyed by the use of nicotine sulphate. The other two pests are of a very minor importance and great damage is not reported.

CONTROL OF BEAN and PEA WEEVIL

The bean weevil which damages the dried beans should not be confused with the Mexican bean beetle which feeds upon bean foliage. The bean weevil adults are a little larger than the head of a match. The beetles visit the beans while they are still in the pod in the field and deposit their eggs on the beans through holes cut in the hull. The young larva

enters the bean and continues feeding on the interior after the beans are hulled and stored. After the insects mature, the beetles gnaw holes to the surface and escape, whereupon a new lot of eggs is laid on the dried beans and the process of destruction continues.

Three methods of control are suggested. If the beans are to be used for food, heating the hulled beans in shallow pans placed in the oven at a temperature of 135 deg. for a period of 30 minutes is the preferred treatment. Since excessive heat may hinder germination, it is not advised for use on seed beans.

If the beans are to be used for seed, a simple protection against damage by bean weevil is to mix the hulled beans with about half their weight of hydrate or air slaked lime. Carbon bisulfide likewise is used for this purpose. The beans are placed in a tight container, and the liquid is poured in a shallow pan set on the surface of the beans. Immediately thereafter, the container is closed tightly and allowed to remain for 24 to 36 hours. An ounce of the liquid carbon bisulfide is sufficient for one bushel of beans. Since this material is highly inflammable and explosive, particular care concerning fire should be taken.

Regardless of the treatment given for bean weevil control, it is best to store the beans in tight containers in order to prevent reinfestation. An unheated storage room is preferred to a warm room, since any beetles escaping treatment will remain inactive in low temperatures.

LILIACEÆ FAMILY

ASPARAGUS

Asparagus officinalis. *Liliaceæ* Family.

(*Hindi*, Soot Moolee; Murchuba; Palagras; *Singhalese*, Hartha-wariya.)

The Asparagus is a perennial plant, native of the sea coasts of Europe and of some parts of Asia. It was used by the Romans at least two centuries before the Christian era, not only for food, but also for its medicinal properties.

The young shoots, blanched by being earthed up, and gathered as soon as the points (spears) appear above ground, are used as a vegetable. The Asparagus is boiled in bundles standing on end in water, leaving an inch or so of the points above the water. This method thoroughly cooks the stems without destroying the tops, which, if they remain a little undercooked by the steam, are readily finished by laying the bundle on its side for a few minutes.

This delicious vegetable grows readily in most parts of India, but in quality it does not compare favourably with the one grown in Europe. A rich, friable, well-drained soil which is loose or sandy should be selected. Clayey soil, which is very retentive of water, is unsuitable. As the Asparagus bed lasts for several years, it requires a very thorough preparation. Dig very deep—say about eighteen inches—and incorporate a liberal quantity of manure with it, a layer of 6 to 8 inches of manure being none too much, as the Asparagus is a very gross feeder.

To start an Asparagus bed, one may either raise his own plants or purchase them ready for use where obtainable. The latter method saves some time, but good Asparagus plants are rarely obtainable in India. The seed beds should be made of very loose, mellow earth, both rich and sandy. The seeds may be sown in drills about 6 to 9 inches apart, at a distance of about half an inch apart in the rows, and covered about an inch deep. When they come up and begin to grow, they must be thinned out, so that they stand about two inches apart in the rows. They should be freely and frequently watered and kept free from weeds and cultivated occasionally, and should never be neglected or allowed to suffer for want of water or sufficient nourishment. Here they may be allowed to grow for about two to four months, according to the season and the growth of the plants. That is, if the seeds have been put in early, they may stand longer in the seed beds; or if they have made quick growth and are getting over-crowded, they must be planted out sooner. When the Asparagus is grown on a small scale, it is generally planted in trenches at least one foot wide and 18 inches or more deep and from 3 to 4 feet apart. The plants may then be set in the centre of the trenches, at a distance of about 12 to 18 inches apart, taking great care to see that the roots are not injured and are spread out carefully. Here the plants should be encouraged to grow luxuriantly, and may be fed frequently with liquid manure.

In cold countries where plant growth is not very rapid, it is not advisable to cut the shoots before the third year, but in our country, a fair number of shoots may be cut in the second year. The ground should be frequently cultivated, working the soil toward, rather than away, from the plants. In the cold season, the stems usually die down and must be cut off. The plants then remain dormant and when they again show signs of active growth at the approach of hot weather, some of the top soil should be removed carefully and a good top-dressing of manure given to the plants which will induce them to throw up many shoots. An application of salt or kainit in the spring, broadcasted at the rate of 2,000 pounds per acre or about 5 pounds to 100 sq. feet, or of pure bone-meal at the rate of from 500 to 1,000 pounds per acre, spread broadcast, then hoed in, will be found very beneficial and profitable. Asparagus is a heavy feeder and it is hardly possible to overdo the fertilizer.

Another way to grow Asparagus from seeds is to manure the ground heavily, plough and prepare it as thoroughly as possible and then put the seed directly into the rows where the Asparagus is to grow permanently, using about two to three pounds of seed per acre. Or an ounce of seed will sow a row about 60 feet long. Cover the seeds about an inch deep and water thoroughly. When the plants come up and are about 3 to 6 inches high, they should be thinned out to stand singly and from 12 to 18 inches apart in the row. Keep the soil constantly stirred and free from weeds, and water copiously when necessary.

On the plains, seeds may generally be sown from August to November or earlier—say in June-July—if the weather is not hot and the rainfall not too heavy; and on hills, from February to May. From 400 to 600 roots will give an ample supply for a family of six or eight persons and 10,000 to 15,000 plants according to width of rows, are required for an acre. 2,000 to 3,000 lbs. per acre may be considered a good yield.

LEEK

Allium porrum. *Liliaceæ* Family.

(*Hindi,* Kirath or Vilaiti Piaz ; *Kanarese,* Kirtha; *Tamil,* Chemay Vengai-thal.

A native of Switzerland. Biennial. It is cultivated for the fleshy stem, which when blanched, forms an esteemed flavouring ingredient in soups and stews. It succeeds fairly well in this country under proper treatment.

The leek is a member of the onion family, but unlike the onion, it does not form a bulb, but a sheaf of leaves. The lower part of the sheaf is solid, and when well blanched is milder and more crisp and tender than the onion. While Onion grows best on dry lands, the Leek flourishes where there is more moisture. The seeds may be sown in seed-beds, and the plants set out in their permanent quarters when about 5 or 6 inches high, in drills about 15 inches apart, and 6 to 9 inches from plant to plant. The Leek is a gross feeder and should be given the richest soil or the best manure. As the plants grow, draw the soil near the stems so that a greater portion of the stem is covered and thus blanched.

On the plains, where the rainfall is light—that is, not over 35 inches or so—and weather not hot, sow from July to October. But where the months of July-August are hot, defer sowing till the heat has subsided, and sow in September or October. Where the rainfall is heavy, sow when the rains are nearly over. On the hills, from March to May, and also in the autumn, if protection from severe weather is given. One ounce of seed will sow a row 100 to 150 feet long, and 4 to 5 pounds will sow an acre. They take about three months to be ready, though they may be left in the ground much longer.

(For Diseases, see under Onion.)

ONION

Allium cepa. *Liliaceæ* Family.

(*Hindi,* Piaz; *Singhalese,* Lunu; *Kanarese,* Neerulli, Erulli; *Telugu,* Yaragadda or Ullagada; *Tamil,* Vengayam; *Malayalam,* Vengayam.)

This is a hardy biennial, supposed to be a native of Central or Western Asia. It is one of the oldest vegetables known; also one of the most extensively used. It not only contains considerable nutriment and has valuable medical properties, but is most useful in counteracting the bad effects of sedentary life. The disagreeable odour it imparts to the breath may be avoided in a great measure by thorough cooking, or by eating a few leaves of Parsley.

The Onion will grow well in a rich, friable, well-manured soil which is not too heavy. The bed or field should be prepared very carefully, the soil worked to a loose, fine condition and made quite rich with well-rotted manure, poultry droppings, if available, and wood-ashes. The seeds may be either sown direct where they are to grow, in rows about a foot apart, and the seedlings thinned out to a distance of about 3 to 4 inches; or they may be transplanted from the seed-beds, into their permanent quarters at the above distances. When seeds are sown, the drills may be made about half an inch deep and the seeds covered to about the same depth and firmly pressed down with a board or light roller.

The ground should be frequently stirred and watered copiously whenever necessary. No weeds should be allowed to grow and when the plants have half grown, a top-dressing of manure or wood-ashes will be found very beneficial.

On the plains, sow from August to November; and on the hills, from February to June. An ounce of seed will sow about 150 feet of drill; and 4 to 5 pounds will sow an acre. They take about 5 to 6 months to get ready. The average yield per acre is 15,000 to 20,000 lbs.

When the plants begin to die down, stop watering and after they are pulled out, expose them to the sun for 2 to 3 days before storing.

The Common diseases associated with Onion and Leek are:—

Downey Mildew The fungus makes its appearance on leaves. The attack usually is very slight. Bordeaux Mixture can be used with advantage.

White rot of Onions The fungus makes its first appearance on leaves. They turn yellow and dry up. The attack subsequently spreads to the tuber in the form of white fungus growth causing it to dry up. Control measure does not appear to have been investigated.

Smut The disease makes its first appearance on older leaves and spreads to the rest of the leaves which causes drying up of plants. The only control measure is a preventive method. Soil treatment before planting with 50% formalin has been found useful.

MALVACEÆ FAMILY

LADY'S FINGERS (GUMBO OR OKRA.)

Hibiscus esculentus. *Malvaceæ* Family.

(*Hindi,* Bhendee, Ram Turai, Bhindi Tori; *Singhalese,* Bandakka; *Kanarese,* Bendekayi; *Telugu,* Dosa Kayi or Benda; *Tamil,* Vendaikai; *Malayalam,* Vendakka.)

According to some writers, it is a native of Africa, where it was cultivated for several centuries before the discovery of America. According to others, it is a native of South America and the West Indies. It is a tropical or sub-tropical plant of an annual duration. This vegetable is very extensively grown in India and other warm countries. It is an erect-growing plant, from 2 to over 3 feet in height, and producing seed pods which when young and tender, are extensively used for eating, either cooked or in soups.

Its cultivation is very simple. The soil and fertilizer requirements of Okra are similar to those for Cotton. The crop will do well on soils ranging from sand to clay, so long as they are well drained, fertile and well supplied with organic matter. The best results, however, are produced on a friable, highly manured loam. If a side-dressing of some quickly-available nitrogenous fertilizer is applied once or twice when the plants are growing, it will have a very stimulating effect on the plants.

The seeds may either be sown direct in the ground where they are to grow, or transplanted from their seedling beds. The first method is preferable. Sow them in drills about 3 feet apart and 1 foot from plant to plant. The seeds of the better, imported varieties are rather tender and cannot stand too wet or cold soils, and often fail to germinate satisfactorily or at all. The imported (American) varieties, being comparatively free from the spiny hairs found on the pods of most of the Indian kinds, are preferred by many. The seeds should be sown from 1 to 2 inches deep. If the seeds are soaked in water for about 48 hours or until the seed-coat splits, a higher percentage of germination can be secured, as the seeds have a hard coat and are benefited by immersion in water. But then they must be sown immediately after, otherwise they are liable to die.

On the plains, sow from May to December; and on the hills from April to June. In Northern India, on the plains, the seeds are generally sown only from May to July. One ounce of seed can sow a row about 75 to 100 feet long. Six to eight pounds of seeds are required to plant an acre. They take about 2 months or a little more to be ready for the table. If the pods are not allowed to mature on the plants and form seeds, the plants will bear pods for a longer period.

The yield of Okra is extremely variable. The time of planting, the variety used, the amount of culture and fertilizer used, the fertility of the land and the amount of rain during the growing season, are contributing factors. When pods are cut while young, for table use, and not allowed to mature on the plant, a single stem will produce from 25 to 40 pods in one season. From 5000 to 8000 lbs. can be expected from an acre of land, under favourable conditions.

Dried Okra seeds are sometimes roasted and used as a coffee substitute.

The diseases and pests are:—

The two minor diseases are Fusarium Wilt and Leaf Spot. In case of wilt, removal and destruction of the plant is the only remedy. Bordeaux mixture has been found useful with Leaf Spot though rarely practised.

The insects that damage the cotton crop also damage this vegetable and they are boll worms (*Earias fabia* and *E. insulana*). The larva bores into the pod and deteriorates the quality of the pods. Sometimes the damage is so serious that they are useless for consumption. Usually the damage is greatest in winter crop. The control method practised at present is the removal and burning of affected pods. Other minor pests are the Semilooper Caterpillar (*Cosmophila* and *Acontia*) and the Jassids. The pests are not serious and control methods are not usually practised.

ROSELLE (Red or Indian Sorrel.)

Hibiscus sabdariffa. *Malvaceæ* Family.

(*Hindi*, Patwa or Lal Ambadi; *Telugu*, Gogu (Main crop), Punti Kuru (Grown for leaves); *Tamil*, Seemay Kasi-lee.)

Annual. Native of West Indies.

It thrives well in almost every part of India, growing to a height of 3 or 4 feet. The fruit, or rather the large, thick, succulent sepals which enclose it, is pleasantly acid and is used in making tarts, jellies and chutnies,

The jelly made from it is considered by many to be superior to Guava jelly and closely resembles Red Currant jelly in taste and flavour. Sometimes, the fully matured sepals are dried in the sun and stored in bottles and used in vegetable curries, etc., in small quantities. It imparts a red colour as also a pleasantly acid flavour. The plant is very ornamental with its large yellow flowers and crimson eye. The flowers are followed by red fruits which are set thickly on every branch. One ounce of seed will produce about 600 to 700 plants.

On the plains, where the rainfall is not much over 60 inches annually, sow about the end of May or even a little earlier if the weather is not very hot. In places with heavier rainfall, it is better to sow when the rainy season is three-fourths over. As it takes a long season to mature (about 5 to 6 months), and is very susceptible to severe cold and frosts, it is difficult to grow successfully on the hills of Northern India. But if the seeds are put down early in the Spring after danger of all frost is over, the plants may produce fruits before the cold weather sets in. In the hill stations of Central and Southern India, it can be grown more successfully. The seeds may be sown where they are to grow, and the plants thinned out to a distance of about 3 feet apart each way. The thinnings may be transplanted to another part of the garden. In Northern India, where the cold weather is severe, it is generally sown much earlier—say during April and May.

MESEMBRYANTHEMACEÆ FAMILY

New Zealand Spinach *(Tetragonia expansa. Mesembryanthemaceæ* Family.*)*—Native of New Zealand. Annual. This plant is quite distinct from the ordinary Spinach, but is an excellent substitute for it in hot weather, and in places where the common or so-called English Spinach is difficult to grow.

The plant is of rapid growth, spreading quickly to a distance of over two to three feet, bearing numerous fleshy leaves, which when well-grown in a partially shady situation are used exactly as ordinary Spinach, the tender tips only being used.

POLYGONACEÆ FAMILY

RHUBARB

Rheum. Polygonaceæ Family.

Perennial. Native of Mongolia.

This plant is not much known in India, and very little grown except on hill stations and in cool localities. But it is extensively cultivated in Europe and America for its large, thick leaf-stalks, from which delicious tarts and preserves are made. It is also used as a vegetable.

In localities where the Rhubarb is grown, it is generally propagated by division of the roots. It can also be raised from seeds, but the different varieties do not come quite true from seeds and exhibit great diversities of

character. In localities where it thrives, its cultivation is simple. For its best development it requires a deep, rich, well-drained soil and a partially sheltered or shady situation. The seeds may be sown in drills about a foot apart, and the plants allowed to stand about 4 to 6 inches apart in the drills. Here they may be allowed to grow for some time until they begin to crowd. Then they may be transplanted into their permanent quarters in a well-manured bed, at a distance of about 3 to 4 feet apart each way. Here the plants are allowed and encouraged to make a good growth for about a year, before the stalks are pulled for use. As the plants will yield for three or four years or even longer, the preparation of the ground should be thorough and deep, and the beds should be top-dressed about twice a year with some good, well-decayed manure. If bone-dust is mixed with the manure, so much the better. No flower stems should be allowed to form seeds, as otherwise they will exhaust the plants.

Rhubarb can also be forced easily. Get large, well-grown roots, not less than two years old, from the open field, and put them upright in a box or barrel as closely as they can be wedged together (with a little soil shaken in to fill the interstices between the roots) under the stage or benches of a green-house or in a warm cellar, when the temperature averages about 50 to 60 degrees F. with a moderate amount of moisture. Light is not necessary. When the stems are grown in the dark, they are blanched and are more tender.

In the fertile soil of Assam, it is known to grow fairly well even at low elevations, withstanding rains and heat. In favoured localities like Bangalore and other semi-hill station like places, it is worth trying. The seeds may be sown about the middle of the rainy season. In the south, it grows well on the Nilgiri hills and, if one or two year old plants are obtained and planted on the plains during September-October, they would yield during January-March.

On hills of high elevations, it does very well. The seeds are sown during March or April and again in autumn.

SOLANACEÆ FAMILY

CAPSICUM OR CHILLI (PEPPER.)

Capsicum annuum. *Solanaceæ* Family.

(*Hindi*, Mirch; *Singhalese*, Malumiris; *Kanarese*, Menasinakayi; *Telugu*, Seemay Mirapa Mirapakaya; *Tamil*, Mulakai; *Malayalam*, Molaku.)

These are well-known annual and perennial herbs, extensively cultivated throughout India. They are natives of the West Indies, China, Brazil, India and Egypt. There are several distinct varieties, but, as a general rule, the small-fruited kinds are hot and pungent and the large-fruited kinds are very mild-flavoured. The latter are commonly used as a vegetable, cooked somewhat after the manner of Brinjals, stuffed with meat or some vegetables.

The Capsicum thrives best on a light, rich soil, well-tilled and well manured. The small-fruited kinds are hardy in our country and can be grown at almost any time of the year, the best time being from April to June, both on the plains and the hills. Sow the large-fruited, mild-flavoured varieties, from August to September on the plains or even earlier—say in June-July—where the weather is not very hot and the rains not too heavy; and from April to end of May on the hills. The seeds are rather slow in germinating and take about two to three weeks to come up. They must be sown in well prepared seed-beds and, when about three inches high, carefully transplanted into their permanent quarters in rows about 2 to 2½ feet apart, setting the plants at distances of about 12 to 18 inches apart, according to the variety grown and the nature of the soil.

In some parts of India, Chillies are grown as an unirrigated crop. For this purpose, a black or retentive soil is selected and the seeds are sown in seed-beds and watered by hand or otherwise, till the plants are transplanted into the field which has been thoroughly cultivated and well manured. This is done about the beginning of July, choosing a cloudy or wet day. After-culture consists in weeding and in cultivating three or four times. The fruit ripens about 3 months after transplanting. Picking goes on for 3 to 5 months according to variety and soil. The irrigated fields naturally yield longer and more.

Capsicums of a fairly good size can be easily grown in any kitchen garden with very little trouble on almost any kind of soil, provided it is well prepared and well manured. An ounce of seed will produce a thousand or more plants and about half a pound of seed will sow an acre. Most of the varieties produce green fruits when young which later, as they ripen, change to bright red. A few varieties are bright yellow, violet coloured, black, or yellowish white.

Insect pests

Chillies are subject to the attacks of three or four insect pests of which the "Chillies Thrips" *Scirtothrips dorsalis*, H. which causes the leaf curl disease is the most important. The adult insect is a tiny one, yellowish brown in colour, elongate in form, and has four wings. Eggs are laid by the female thrips inside the tissues of the leaves and the young ones hatch out in 4 or 5 days and begin to feed on the tender shoots. A very effective remedy is to dust the infested plants with tobacco dust or spray with tobacco decoction and soap.

Tobacco dust can be prepared by pounding waste tobacco to a fine powder and applied over infested plants by means of a dusting machine.

Tobacco decoction is prepared by boiling one pound of waste tobacco in one gallon of water for half an hour or by steeping it in cold water for 24 hours and dissolving 2 or 3 ounces of ordinary bar soap in the decoction. This is to be diluted with five gallons of water and sprayed on the affected parts, at intervals of a few days.

(We are obliged to the Director of Agriculture, Madras, for allowing us to reproduce the above information on insect pests of chillies from "The Villagers' Calendar, 1938.")

EGG PLANT OR BRINJAL (Aubergine.)

Solanum melongena var. *esculentum*. *Solanaceæ* Family.

(*Hindi*, Baigun; *Marathi*, Wangee; *Kanarese*, Badne-kayi; *Telugu*, Van-kaya; *Tamil*, Kathiri-kayi; *Malayalam*, Vazuthananga.)

A native of India and North Africa. Though a perennial, it is cultivated as an annual. It is very largely grown in India and many other tropical countries, where it is one of the principal vegetables.

The best soil for the Brinjal is a rich, warm, light or sandy loam, well manured and deeply tilled. The seeds are first sown in seed-beds, and when the plants are large enough to be handled, they are planted out in the ground, in rows about 3 feet apart and 2 feet from plant to plant. As the plants grow, cultivate the ground frequently, keeping it free from weeds and feeding the plants with liquid manure occasionally. Being purely tropical, it cannot stand any frost.

On the plains of Central and Southern India, where the rainfall is light, sow at the beginning of the rains, and also from September to November. In Northern India, the seed can be sown three times a year, in February, July and October. Thus a very long season of sowing allows the fruit to be had almost throughout the year. On the hills, sow from the end of March to the end of May. An ounce of seed will produce at least 1,000 plants and about 5,000 plants are required for an acre. They produce an average of 4 to 5 fruits to a plant, sometimes as many as 10. They take from 120 to 160 days to be ready. The average yield per acre is from 7,000 lbs. upwards, though sometimes double, or even more than double this quantity may be expected. The Brinjal is a gross feeder. Not less than 20 tons or about 40 cart-loads of farm yard manure (well decomposed cattle dung) should be given per acre. In addition to above, about 1,000 lbs. of chemical fertilizer, consisting of 5 parts of nitrogen, 8 parts of phosphoric acid, and 7 parts of potash by weight, may be given with advantage. Where cheaply obtainable, a mixture of 1500 lbs. of castor oil cake and 550 lbs. of crude saltpetre given per acre, will give excellent results. Fish guano, where it can be had cheap, is also a good manure and yields excellent results.

The common diseases and pests of the family are:—

Leaf Spot The fungus attacks the leaves and the fruits. The affected fruits get rotten and are rendered useless. Bordeaux mixture spray has been found useful.

The vegetable is attacked by a few pests chiefly borers and leaf eaters.

Borers The shoot and fruit boring caterpillar (*Leucinodes orbonalis G*)— It is a short, stout caterpillar with a pinkish colour and bores into the shoots of young plants and into the fruits. The adult is a grey brown moth with whitish wings having pinkish brown markings on them. The full grown caterpillar measures about 2/3 of an inch in length, and pupates in a boat shaped cocoon of dirty brown silk on the plant itself. The borer in some bad years is responsible for damage upto 25 per cent. and reduces the quality of the brinjal.

The stem borer (*Euzophera perticella R*)—The caterpillar, pale whitish in colour confines its activities to the stem only. Pupation is

within the stem resulting in a grey brown moth. The infected plants gradually fade and die. The pest is not very common and the damage in a bad year would not be more than 10 per cent.

The Bud-worm (*Phthorimoea blapsigona*)—A serious pest damaging the crop from 20 to 45% on Madras side. The caterpillar, small pale whitish or pinkish in colour bores into the tender buds and prevents fruit formation. The adult is a small brown moth very similar to the potato borer moth.

All the three insects are controlled by preventive measures only. Destruction of first attacked shoots, fruits and buds helps in lowering down its population. The bud worm is controlled in nature by an insect parasite —a species of microbracon.

Epilachna beetles Pale brown spotted beetles and their grubs cause damage to the extent of 5 to 10 per cent. to leaves and tender parts of plants. Hand picking is the usual practice of control. Calcium, magnesium and lead arsenate are useful as insecticides in cases of heavy attack.

Leaf Caterpillars Among the leaf caterpillars the most important is a leaf folder (*Eublemna olivacea*). The insect, a stout purple-brown caterpillar with yellow spots and hairs and whose adult is an olive-green coloured moth, rolls up the leaves and feeds on the green matter in the roll. The other two minor pests of leaves are sphnix caterpillar (*Acherontia Styx W.*) and a small greenish caterpillar (*Phyetia clientella Z*). All these pests can be controlled by arsenical stomach poisons but usually they are not so serious as to warrant the use of an insecticide.

Other minor sucking insects damaging the crop are lace wing bug (*Phenacoccus insolitus G*) and the dark bug (*Anoplocnemis phasiana F*). These insects cause very little damage to the leaves thus affecting the normal growth of plants. Removal of affected parts is the best preventive control practised. Tobacco, dry or decoction, may be used with advantage.

TOMATO

Lycopersicum esculentum: Solanum Lycopersicum. Solanaceæ Family.

(*Hindi*, Bilaetee Baigun; *Singhalese*, Takkali; *Telugu*, Sema Venga or Pandiri Venga; *Tamil*, Seemay Takalee or Takkali-kai.)

Native of South America. Annual.

This well-known and favourite vegetable is very largely and successfully grown in all parts of India. It is a branching plant with a flexible stem, requiring artificial support to grow erect. It is a plant which grows best in cool localities, though it will not stand very cold weather or frost.

In Europe and America, in localities with long winters, the Tomato requires to be started in artificial heat, but here in our country, it is grown very successfully out of doors. The seeds which usually germinate very freely should preferably be first put down in seed-beds in rows, and when about 2 to 3 inches high, they may be transplanted in their permanent quarters. If the seedlings are transplanted twice before they are finally set out in the garden, they will form stockier and hardier plants and will yield better. They may also be sown broadcast. When sowing, the seeds should

not be covered more than half an inch, and about four seeds may be put down to every inch of drill. The Tomato thrives in many kinds of soil, provided that it is well-worked and fertilised. In light, sandy soils, the fruits are inclined to mature earlier than in heavy soils. As the plants take up much room, they are generally put down in rows at least three to four feet apart and about 2 to 3 feet apart from plant to plant in the rows. When grown in the field, the plants are allowed to spread on the ground and are not given any support.

When only a small number of plants are grown, it is advisable to train them on some support. Use strong stakes about 5 to 6 feet long, and insert one near each plant when about a foot high and tie the plant rather loosely with some soft twine which will not cut into the stem as it thickens. Remove some of the side shoots if they come up too thick, and train the plant on one stem. Or, instead of one long support, use the following plan, which has the merit of being cheap and neat, and can be followed in a small as well as a large garden: Midway between two rows of plants, drive stakes (about 5 to 6 feet long) at any convenient distances, to the top of which a scantling or a bamboo is nailed. Across this scantling tie sticks with lower ends sunk in the ground; set the plants at the foot of each stick, and tie them to the sticks as they grow.

Though the Tomato does not require a very rich soil, its chief need is nitrogen in the soil, which can be supplied in various forms. Stable manure which is rich in ammonia and which also supplies nitrogen; nitrate of soda, nitrate of potash, dried blood, chicken manure, etc., are all beneficial. The rapidly growing Tomato vine makes heavy demands on the plant food in the soil. As the fruit begins to develop, an added drain is imposed on the available nutrients, with the result that the fruit usually suffers. The addition of nitrogen, in some readily available form at this critical stage, results in a greater percentage of the fruit reaching maturity, hence higher yields. Applications of nitrate of soda or sulphate of ammonia at the rate of 75 to 100 pounds per acre have given excellent results. Larger amounts than above should be avoided as they may over-stimulate vine (leaf) growth. In places where the temperature is usually high, try to give the Tomato plants as good and deep a soil as possible. If the roots of this plant are near the hot dry surface, they do not thrive and many times the plant dies, without any apparent reason. Cultivate the soil as frequently as possible, keeping it free of weeds. It is necessary that the plants are not checked in their growth, especially while they are young, either for want of water, over-crowding in their seedling stage or too poor soil.

On the plains, where the rainfall is not heavy, sow from June-July to October. Where the rainfall is very heavy, sowing must be delayed till the rains are nearly over. On the Hills, sow from March to May. We have had reports from Erinpura (Rajputana), that the Tomato does better there during the summer and is less liable to diseases than at other times.

In Northern India where frosts occur, the Tomato plants require a sheltered situation and some protection. For this purpose, the plants are put down rather closer together in sets of two or three rows, allowing a space of 1½ feet between the rows, and about the same distance from plant to plant, and then a space of 3 or 4 feet is allowed between each set of rows as a

pathway. When frost is prevalent, or when the nights are exceptionally cold, the plants should be covered every evening with mats or grass tatties, until the weather becomes mild.

Unfortunately, the Tomato is subject to several diseases and insects. The Horn Worm which attacks both the Tomato and the Tobacco can be controlled by timely applications of arsenate of lead. It should be sprayed as soon as the worms make their appearance. Sēveral applications may be necessary during a season. Then, there is Blight, a bacterial disease, which produces a wilting of the plants. No remedy is known except to grow wilt-resistant varieties in soil where Tomatoes or allied plants have not previously been grown. The Rot is another disease which first shows itself on the blossom-end of the fruit when about half grown. Three or four applications of the Bordeaux Mixture should be made at intervals of two weeks, making the first application as soon as the fruit begins to set.

An ounce of seed produces over two thousand plants, and about three to four ounces are sufficient to plant an acre. The plants begin to ripen fruit three months after the seeds are sown, yielding good supplies for several weeks in favourable weather. The yield varies greatly under different conditions. Under ordinary field culture, an acre should yield at least about 10-15000 lbs. of fruit. If paper bags are tied over the green fruits, while on the plants, ripening is hastened by a few days.

The common diseases of tomato are:—

Mosaic: The fungus which attacks tobacco and potato also attacks this crop. The leaves are affected by the fungus and in consequence the plants do not come up normally and the bearing is very poor. Uprooting and burning the diseased plants is the only remedy.

Anthracnose or Ripe Rot The fungus attacks the ripe fruits and forms soft spots due to which ultimately the whole fruit gets rotten. Collection of affected fruits and destruction is the only preventive control measure.

Brown Rot of green fruits The fungus attacks green unripe fruits and before they can ripen they begin to rot. Water logging should be avoided and the plants should be trailed to avoid the disease.

Fusarium Wilt It is a root disease and spreads from the root to branches and leaves causing the plant to die. Removal and burning of the affected plants is the only control method adopted at present.

Leaf Spot The fungus makes its appearance on the leaves causing small brown patches. The fungus is more on the lower surface of leaves than on the upper surface. Bordeaux mixture has been found useful for control.

Leaf roll of Tomato A disease which causes leaf curling resulting in very low bearing and the fruits remain small. Gradually the plants die out. The only known method of control is destruction of diseased plants.

The Tobacco Caterpillar (*Prodenia*) is often very destructive to tomato leaves, shoots and fruits. The damage in a bad year amounts to about 50 per cent. The insect is noticed to cause damage during night and hide in the soil during day. Spreading lead arsenate in wheat bran under plants on soil helps control of the insect pest.

(The following article is reproduced from "The Gardener", April-June 1939, by kind permission of the author.)*

Recent Advances In Tomato Culture

By GEORGE H. COPLEY, N. D. HORT.

In the comparatively short space of fifty years, the tomato has, in popular conception, changed from an uninteresting botanical species to a crop of major commercial importance. It is interesting to observe that in 1938 no less than 7,000,000 lbs. of the fruit were grown in Great Britain alone for human consumption. That, of course, takes no account of the large quantity of tomatoes that are grown by amateur gardeners. Few of the latter are not interested in this crop.

It follows, therefore, that by sheer virtue of its importance, tomato growing has attracted the attention of research workers. Intensive cultivation always brings its problems, which for their solution need the attention of the trained mind. It is my object in this article to describe for the information of my colleagues in India some of the practical conclusions at which British research workers have arrived.

The Control of Virus Diseases

During the past few years several virus diseases have attacked the crop. There is Ferny Leaf, so called because the leaves of affected plants are much divided, like those of a fern. They lose all cropping capacity, the flowers dropping prematurely. Another form is the Distorting Virus, which has a crippling effect on growth. The stems spindle, or become much thinner than usual, the foliage is twisted and malformed, and growth ceases. Thirdly, there is the Variegated or Ancuba Leaf Virus, thus described because the leaves bear a yellow mottled variegation. In this case cropping capacity is not entirely wiped out, though the yield is very poor, and the fruit is deficient in flavour.

Most diseases that attack the tomato can be destroyed by spraying. The virus troubles do not yield to that treatment because no part of them is external. Exactly what a virus is has yet to be defined, but we do know that it is some sort of a sap poison which has a most deplorable effect on development. It will be seen, therefore, that external spraying against an internal infection of this description is valueless.

Yet it is possible to keep tomatoes clear of the virus trouble. In the first place, the seedlings should be carefully scrutinised. Throw away any that show the least indication of the symptoms described above. Watch the plants in the early stages after final planting. At the least hint of trouble, water them weekly for a month with sulphate of potash solution (one ounce in a gallon of water and 2 pints per plant per dose). This treatment undoubtedly has a safeguarding influence.

Another important precaution is to keep down aphides and other sucking insects. The former group in particular are known to be vectors or carriers of the disease. With their proboscis they pierce the tissues and inject the virus. Fumigation, or spraying with an approved insecticide, exterminates

* Formerly published by Pestonjee P. Pocha & Sons, Seed Merchants, Poona.

these enemies. Further, it is highly important that those who smoke cigarettes or a pipe should not handle the plants with nicotine-stained fingers. The tobacco and the tomato plants both belong to the Natural Order *Solanaceæ*. Both are liable to the same virus troubles. It has been demonstrated beyond challenge that tomatoes can be infected by nicotine stains.

The Value of Straw in the Sub-soil

Most tomatoes are grown in permanent borders which some time before planting are mock-trenched or dug 2 feet deep. It has been proved that when straw is incorporated into the sub-soil or bottom one-foot layer at the rate of 3 lbs. per square yard, the yield is greatly enhanced. The straw—wheat, barley, or oat, the first-named for preference—should be chopped up into pieces 6 in. long, and worked in upright. That is to say, the straw is not laid in the trench after the manner of manure, but is set up on edge and surrounded by soil. This method, which makes a most salutary difference in the crop in every way, operates favourably because the straw supplies humus in its most valuable form. It also aerates the soil. The two factors, acting in unison, encourage deep rooting, a characteristic that is essential if the plants are to yield to their maximum.

Stopping the Plants at the Fourth Truss

Until a few years ago, British growers were satisfied with a 5 to 6 lb. per plant yield. It must be understood that the varieties grown yield from 6 to 8 fruits per lb. Now the yield is often 12 lbs. per plant and more. The greater output is not due entirely to improved varieties, but to the discovery of the fact that when the plants are stopped one leaf above the fourth truss, and the top resulting side-shoot carried on for fruiting, pristine vigour is restored. The main stem, instead of weakening to such an extent that it can carry nothing more than small trusses of fruit, is vigorous enough to bear trusses of the largest size. I have no hesitation in recommending this method, which, I would add, has an equally helpful influence where larger varieties of the Ponderosa type are favoured.

Damping off and Tomatoes

Tomato varieties are undoubtedly highly bred. The seedlings are very susceptible to attack by the damping-off fungus *(Pythium Debaryanum)*. As is well known, this parasite can make shipwreck in the seed vessel. The mycelium devastates the internal tissues, while the spores cover the tiny plants in the form of a white mould. Owing to the close proximity of the seedlings, wholesale destruction is very rapid.

Another early trouble is foot rot or staggers, due to the fungus *Phytophthora parasitica*, which after the plants get out of the fragile seedling condition, attacks the base of the main stem. The tissues shrivel, and the plant falls over as though it were intoxicated, never to rise again. This parasite ceases its attention after the plants begin flowering.

Needless to say, careful watering with pure water, and the maintenance of airy conditions are excellent safeguards. They are essentials of successful growth. But even where these attentions are faithfully given, immunity is by no means certain. For that reason it was considered necessary to seek a complete preventive, and this has been found in Cheshunt Compound, a preparation evolved at the famous Cheshunt Research Station in Hertfordshire, England. The formula of the compound is carbonate of ammonia 11

parts, powdered bluestone or sulphate of copper 2 parts. Mix the ingredients thoroughly, and store them in a cool cupboard in a tightly stoppered jar. At fortnightly intervals from the appearance of the seedlings until the flowers open, dissolve one ounce of the compound in 2 gallons of water, and water the seedlings with it. Not one will then fall before either of the enemies mentioned. Incidentally, treatment with Cheshunt Compound on the lines indicated is an admirable safeguard against damping off and foot rot diseases, no matter what the type of seedling.

The Peat Top-dressing

The average yield of tomatoes under good conditions in Great Britain is 50 tons per acre. Ten per cent. of this is considered to be due to top dressing with granulated peat. The top-dressing is applied when the bottom truss of fruit is nearly fully developed. The soil at the top of the border, boxes, or pots, is loosened with a hand fork, watered well, and a 2-inch layer of peat spread on the surface. This humus material is soon tenanted by hosts of small white feeding roots. Probably there is mycorhiza. That has yet to be demonstrated, but at any rate the research workers can be left to settle that. The practical grower can apply dressing in the knowledge that he will get a much heavier yield.

Permanganate of Potash and Tomatoes

"Tomatoes were made the subject of experiment too. The effect on them was most marked and beneficial. Twenty-four plants of even growth were set separately in 48's pots and watered with solution at weekly and fortnightly intervals. Control plants were, of course, grown, so that results could be compared.

"Two strengths of solution were used, namely, one ounce of permanganate dissolved in 2 gallons of water, and ¼ oz. dissolved in 2 gallons of water. In each case the individual application was 250 cc. per pot. Some of the plants were watered weekly with the weak solution, others weekly with the strong solution. Some again were watered fortnightly with the weak solution, others fortnightly with the strong.

"It is clear that when tomatoes are watered weekly with the strong solution given above, the prospects of a heavier yield are considerably enhanced. Undoubtedly the tomatoes gained because the permanganate of potash decomposed humus in the compost, and made it and food available to the roots.

"I commend the treatment, not only for tomatoes, but for any and every plant grown. It can do nothing but good."

UMBELLIFERÆ FAMILY

CARROT

Daucus carota. Umbelliferæ Family.

(*Hindi*, Gajar; *Telugu*, Gazara; *Tamil*, Gajal.)

This is a hardy biennial, and a native of Europe and the Western alayas. The roots of this plant, when artificially developed by vation, exhibit the widest differences in shape, size and colour.

Carrots require a good, light, warm soil, deeply tilled and preferably manured a few months beforehand. Other soils will also grow fairly good Carrots but a very stiff heavy clay is not suited to it. Carrots require a liberal amount of potash. If artificial fertilizer is used, the best combination is 5 percent. nitrogen, 6 acid phosphate, and 10 potash.

The cultivation of the Carrot is very simple. The seed is sown where the plants are to grow in rows about 10 to 12 inches apart and when the plants come up and are about two inches high, they must be thinned out to distances about 3 to 4 inches apart. The long varieties of Carrot may be planted in drills from 12 to 15 inches apart and should be thinned out to distances of about 6 inches. Carrots for the table should be pulled when about half grown as they are tender then. If the thinnings are judiciously performed and not done all at once, it is possible to pick very small and tender Carrots (as some are likely to be very early), thus making room for others to come on.

On the plains, where the rainfall is not heavy—say, under 30 inches annually—and the weather not hot, sowings could be made even during rains, but the best time to sow is from September to November. On the hills, sow from February to May; also in autumn with protection. During the earlier stages of their growth, the Carrot plants should be carefully watched and no weeds allowed to grow, and they should not be made to suffer for want of water, as they are rather weak when young. By making successional sowings, good Carrots may be obtained for quite a long time. For soils which are naturally not deep, the modern short or stump-rooted varieties are very good.

One ounce of seed will sow a row about 125 feet long, or about 4 to 5 pounds are required per acre. Early sorts are ready for use within 60 to 80 days; late sorts within 100 to 120 days. The average yield per acre is about 18,000 lbs.

CELERY

Apium graveolens. *Umbelliferæ* Family.

(*Hindi,* Salary or Kurass; *Singhalese,* Seldry; *Tamil,* Sallary.)

Native of Europe and the North-West Himalayas. Biennial. The Celery, though not largely grown in India, thrives well almost everywhere, and with care can be grown satisfactorily in this country.

The seeds, which are very small, should be carefully sown in well prepared seed-beds, in drills about 3 to 4 inches apart. They require a partially shady and cool situation and if they come up too thick, should be thinned out, so that the seedlings do not stand closer than about half an inch. The seeds must not be covered with more than about 1/3 to 1/2 of an inch. They are usually slow in coming up, taking about 2 to 3 weeks in favourable weather, and 6 to 8 weeks in dry weather. When they are large enough to be easily handled, they must be transplanted to another place, setting the plants at a distance of about 2 to 3 inches each way. When they have grown about 6 inches high, they may be transplanted to their permanent quarters. Any good garden soil is suitable, but they grow best in a rich, friable, well-drained, rather deep soil. While the plants are growing, it is a good plan to cut off a few of the top leaves; this induces stocky growth.

When grown on a small scale, it is good to dig trenches about 15 inches wide, 18 inches deep, and 4 feet apart from centre to centre. A plentiful supply of well-decomposed manure should be introduced into the trenches, mixed with some fine soil to a height of about 6 to 9 inches, over which may be placed some soot, and then the plants may be carefully planted in the centre at a distance of about 6 to 8 inches apart. As they grow, soil may be drawn towards the plants, encouraging the plants to grow straight and not allowing them to spread. This blanching process is to be done slowly, and the final blanching is to be done about a fortnight or so before the plants are required for the table or market. Only the upper portion of the leaves is then visible through the soil.

But when Celery is grown on a large scale, the trenching method is done away with, and the plants are set in rows on the level surface. The rows should be four to five feet apart to permit of securing sufficient soil for banking up, but in all cases the soil should be made as rich as possible to secure a strong and quick growth. To a great extent the attractive appearance, delicate flavour, and crispness of Celery depend on the proper blanching of the stalks. This blanching or whitening of the stalks is the result of excluding light during their growth. Blanching may be done in other ways. When the plants have advanced in growth, the outer leaves should be tied round the inner ones and the soil earthed up round the stalks. Sometimes drain pipes or old-fashioned Indian roof tiles or even pieces of large bamboo split into two are used for blanching.

An ounce of seed will produce 5,000 to 6,000 plants in favourable weather, and about 4 to 6 ounces will be sufficient to plant an acre. The seeds should be sown rather thinly in drills as already suggested, one ounce of seed being sufficient for about 150 feet of row. Care should be taken to press down the seeds firmly after sowing, also to press down the soil round the roots of plants after transplanting, so that no hot air can get through the open earth and injure the newly planted seeds or plants. On the plains sow from August to October, and on the hills from February to the end of April; also in Autumn. Celery takes about 4 to 5 months to be ready after sowing seeds. The average yield per acre is about 24,000 lbs.

CELERIAC OR TURNIP-ROOTED CELERY

Apium graveolens Var. Rapaceum. *Umbelliferæ* Family.

In this kind of Celery it is the root which has been developed by cultivation, to the size of a fist, or even double that size. The leaf-stalks remain hollow and of moderate size.

This vegetable, though very little known in India, can be cultivated successfully, and when well-grown in a cool and moist climate, is very delicious, having a filbert-like flavour. Celeriac is cooked in the same manner as Beet, and requires about the same length of time. The roots are trimmed, washed, and put into boiling water without salt or any flavouring, and kept boiling until quite tender; they may then be pared, sliced and served with white sauce, or left uncut to be sliced up for salads when cold. It may also be used for flavouring soups, stews or other dishes.

Cultivation is the same as Celery, except that no earthing-up for blanching is required. The seedlings may be transplanted into rows about a foot apart, and 6 to 9 inches from plant to plant.

PARSLEY

Apium petroselinum. *Umbelliferæ* Family.

(*Hindi*, Petercelee or Ajmood; *Tamil*, Pasli.)

Native of Sardinia. Biennial.

Parsley is grown for its leaves, which are used for garnishing, flavouring, etc. The leaves may be dried crisp, rubbed to powder, and kept in bottles until needed.

It thrives in most kinds of soil, but prefers a rich and somewhat heavy one, and a partially shaded situation. The seeds may be sown in drills about a foot apart and the plants thinned out, first to a distance of three inches, and finally to six inches apart. The thinnings may be planted in another bed and will also yield good leaves. As the seeds are slow in coming up, taking from 2 to 4 weeks, it is a good plan to mix the seeds with some round, red Radish seeds which come up quickly. This method helps in determining the exact place where seeds are sown and the beds may then be weeded and cultivated freely between the rows and the young radishes will be ready much before Parsley plants will need the place. If seeds are soaked in warm water for about 12 hours and then sown immediately, the germination would be hastened.

On the plains, sow from September to November; but where the rainfall is light, sowings may be made much earlier—say from June onward—provided the weather is not hot during these months. On the hills, sow from February to June and also in Autumn. An ounce of seed will sow about 150 feet of drill; and about 3 pounds are required to sow an acre.

PARSNIP

Pastinaca sativa. *Umbelliferæ* Family.

(*Hindi*, Istufeen or Juzur.)

Native of Europe. Biennial.

This plant is cultivated for its fleshy roots, which are eaten boiled, and are also used for flavouring soups. They also make an excellent food for horses in places where it is easily and successfully grown. It thrives best in a deep, rich, loamy soil, free from stones, etc. Its cultivation is similar to that of Carrots. The seeds may be sown in drills about 15 to 18 inches apart and half an inch deep, and the plants thinned out to a distance of 5 to 6 inches apart in the rows. They are much hardier than Carrots, and in cold localities can stand ordinary frosts and are supposed to be improved by it. The seeds being very short-lived and susceptible to climatic changes, cannot always be depended upon for germination. They often entirely fail to come up in hot weather.

On the plains, sow during October to November; earlier, in localities with cool weather and not much rainfall. On the hills, from March to May. An ounce of seed will sow about 150 feet of drill; and 3 to 5 pounds will sow an acre. They take from 80 to 100 days to get ready. The average yield per acre is about ten tons.

FAMILY VALERINACEÆ

CORN SALAD OR LAMB'S LETTUCE

Valerianella olitoria. *Valerinaceæ* Family.

Native of Europe. Annual. This vegetable is much used as a Salad in Europe and America and can be easily grown in India.

Sow the seeds in a well prepared bed, and when the seedlings are about an inch or more high, transplant them into rows about a foot apart, putting the plants at distances of 4 to 6 inches. The seeds may be put down where they are to grow and the plants thinned out to the proper distance apart when they have come up. Sow at the same time as the ordinary Lettuce, but on the Hills, besides sowing at the same time as the ordinary Lettuce, also in the Autumn. They usually take about 6 to 8 weeks to be ready. An ounce will sow a row about 100 feet long; and about 4 pounds are required to sow an acre. The average height of the plants is about 4 inches only.

(*Note:*—We are indebted to Dr. T. V. Ramakrishna Ayyar, and Mr. E. J. Butler, for references on pests and diseases in this chapter, from the publications "Hand Book of Economic Entomology" and "Fungi and Disease in Plants", respectively.)

WHAT IS A SEED ?

A seed holds the germ of plant life. Large or microscopic, it will develop according to variety, into a sky-reaching giant tree or a tiny creeper that hugs the ground.

Quality in seed is not in the seed itself or its appearance, but in the inbred quality of that seed to yield a superior product. Good seed and inferior seed may look exactly alike, but there is an invisible difference, distinctly in evidence at harvest time. Since time and labour are the heaviest expenses of gardening and the cost of the seeds the least, we strongly advocate that you choose your seeds carefully and with discrimination from Seedmen who have a reputation of observing quality and who are actively engaged in maintaining and advocating that precious factor so important and imperative with seeds.

PART V

Lawns, Lucerne, Papaya, Hedge and Guinea Grass.

CONTENTS OF PART V

	Page
Lawns and Grass Plots	159
Lucerne or Alfalfa	162
Papaya, Papau or Papita	163
Hedges	166
Guinea Grass	167

LAWNS AND GRASS PLOTS

The lawn furnishes the setting for a house and if it is trim, smooth, and of a healthy green, will add to an attractive house, the finishing touch which no amount of planting can give.

Many people seem to have a notion that lawns can only be made in extensive gardens and that they are costly to make and keep. Such however, is not the case. Even small gardens can have lawns and except for the initial cost and labour of making one, the upkeep charges are negligible.

In most parts of India on the plains, where weather conditions are not very extreme, lawns can be grown from seeds at all times of the year. Perhaps the least suitable time is the cold weather. The Hariali or Doob grass—which is the one most commonly used all over India—is a great lover of heat and sunshine. The seeds can be sown at any time beginning from 1st March onwards. Avoid sowing before very heavy rains such as the commencement of the monsoon. July, August and September are also good months for sowing.

Most houses have a grass plot or two, but these usually consist of annual grasses and weeds. If, for some reason or other, a permanent Hariali or Doob grass lawn is not wanted, then the existing lawn can be considerably improved by having it constantly weeded. removing all coarse grass and weeds and by manuring, watering, mowing and rolling it occasionally. Bare patches should be hoed, manured and a few grass roots dibbled in. During the rains the appearance of the garden can be codsiderably improved by keeping the grass plots tidy and neat, at very little expense and trouble.

But if you decide to have a good lawn, it is well to remember that thorough preparation of the ground is very essential and is the foundation on which lawns are built. The formation of the lawn is too often hastily and imperfectly done; it is the foundation of all subsequent operations and, if badly done at first, the fault cannot be easily remedied afterwards.

Dig up the ground to a depth of at least one foot or more if possible and remove all roots of weeds very carefully. If the ground is infested with the Indian Nut Grass *(Cyperus rotundus)* which is a very tenacious weed and is very difficult to eradicate, the ground must be dug upto a depth of about three feet, removing all the weed roots. The earth thus dug out should be well exposed to the sun, and turned over at least two or three times, every time removing the roots of weeds. If the soil contains small pieces of stones etc., it should be sifted through a rough sieve and the ground levelled up. Over this level surface put any old, well-decayed manure, about 3-4 inches thick and spade it in, more or less near the surface—say not more than six inches deep. If, however, the soil be very poor or sandy, it is advisable to remove some of the old soil and put in a goodly layer of rich soil, either from a river-bed or some nearby field.

Good drainage is also essential in maintaining a lawn in good condition. Where only small lawns are made and where the soil is not sticky or clayey, special drainage may not be necessary. But where the plot is a large one—say the size of a tennis court or thereabouts—it is advisable to

have surface drains at the ends or sides of the plot, with a proper outlet for the water. These drains should be kept clear throughout the rains, after which, if desired, they may be filled up with earth till the next monsoon. The Doob will not grow in areas liable to become water-logged. For this reason, it is advisable to raise the lawn a few inches above the level of the surrounding paths. A slight camber from the centre to the edges is an advantage. It helps to prevent pools forming when watered.

After having prepared the ground, it should be rolled to make it level and then very thoroughly watered. If any weeds come up, as some are bound to—usually most manures also contain some weed seeds—they should be carefully destroyed. If time permits, it is well to rake up the surface soil again and after levelling and rolling, it may be watered again a second time and weeds destroyed if any come up.

The old method of dibbling Hariali or Doob roots to make a lawn is now superseded by the easier method of sowing seeds of the above grass, which gives a perfect and lasting lawn within a short time. While sowing seeds, it is well to measure off the plot into squares with string, and plant out one square at a time; this ensures uniformity in planting. Prior to sowing, the rolled surface is scarified with a rake to a depth of an inch. The seeds are then mixed with double their bulk of fine sifted soil, broadcasted carefully by hand, and the soil raked over in two directions so as to mix the seeds intimately with the soil. Whilst still dry, it is thoroughly rolled. The rolling is important, as otherwise the seeds will not all come up. Then water gently, yet thoroughly, with a can having a fine rose or nozzle. The Hariali seed is rather slow to come up and usually takes about 3 weeks before it makes its appearance and sometimes as long as 4 to 6 weeks. Sow seeds at the rate of about a pound to every 300 to 400 square yards (or 2700 to 3600 square ft.), or 12 to 15 lbs. to the acre. (One acre is equivalent to 43,560 sq. ft.)

After a few weeks, the grass should be fit for cutting. Before cutting it with a mower, it is advisable to cut the grass with a pair of sharp garden shears so that when the mowing machine is used, it will go over a more or less even and low growth. The ordinary lawn mower is not expected to cut tall or uneven grass. Before mowing, the roller should go over the grass to make it firm. Thereafter, the hand-cutting will not be at all necessary, as every few days the lawn should be rolled and the mower worked over it.

If the seeds have not come up evenly and the grass is thin or sparse in some places, a little raking and re-seeding will fill them up. If any portion of the lawn has sunk, sprinkle thin layers of good earth on the depression, not more than an inch thick at a time, to bring it to the level, so that the grass may not be covered up or injured by too deep a covering of earth.

Watering must be thorough and as frequent as weather conditions require. It is not necessary to flood the lawn as the doob grass is not a very deep-rooting plant and too much watering is likely to encourage other deep-rooting weeds. In very dry weather, daily watering may be necessary, but otherwise watering should be given every two or three days. A rubber-hose attached to a municipal water-pipe is a very efficient way of watering and is preferable to water-cans or buckets. If water-sprinklers which distribute water evenly over a good surface at a time, are used,

much of the mali's time will be saved. Then it is only necessary to shift the position of the sprinkler from time to time till the whole surface is covered. But for this purpose there must be sufficient pressure in the water-pipe.

The Doob or Hariali is essentially a sun loving plant and will not thrive in dense shade. If there is moderate shade, it is necessary to prick the soil occasionally with an iron spike to aerate it. Constant weeding, watering, rolling, mowing and occasional manuring will ensure a perfect lawn. To stimulate the growth of grass, apply liquid manure made from cow or horse dung. Avoid farm-yard or other ordinary manures as a top-dressing, as usually they contain weed seeds. Nitrate of soda or sulphate of ammonia, diluted in water (an ounce in every two gallons) and given occasionally, is a wonderful stimulant. A top-dressing of finely sifted leaf-mould 6 parts, fine sand 12 parts and bone meal 1 part, given every six months is also excellent. (See also page 172, formula X.)

Weeding a lawn is as necessary as weeding a flower bed. Regular weeding once a fortnight will not take much time and will ensure a long life to your lawn. Never allow weeds to take a hold. Be particularly on the lookout for the pests that usually attack all lawns: the Indian Nut grass with its underground bulbous roots and the blue weed with its flat leaves and creeping habit. The first few weedings may be more frequent but as the turf becomes compact, it itself tends to smother most weeds.

Dew which we generally experience during the cold weather, is a great help to growing grasses and it is advisable to take the full benefit of it, by brushing it into the lawn either with a light bamboo switch or rolled in with a light wooden roller. The former is preferable.

During the rains, no stagnant water should be allowed to remain on the lawn, or it will kill the grass, leaving bare patches. If the ground appears to be sodden, and a green slime-like substance forms at the roots of the doob, a sprinkling of crushed lime-stone will sweeten the soil and get rid of the wet patches. The constant rolling, mowing and watering sometimes cause the compacting of the surface, preventing subsoil water from rising. This is especially the case where there is more rolling and less watering. In such cases, a light top-dressing of rather coarse sand is recommended. It prevents the formation of surface-crust and is otherwise beneficial to grass growth. If, once a year, the entire surface of the lawn is torn off by the vigorous application of a sharp rake, the result, though it may at first appear tragic, will be greatly beneficial to the lawn, as it will rapidly grow again and be even smoother and more brilliant than before.

The following hints on the uses of permanganate of potash in relation to lawns are reproduced from the article "Some Valuable Experiments with Permanganate of Potash" by George H. Copley, N. D. Hort. in "The Gardener" for April-May-June 1939, published by Pestonjee P. Pocha & Sons, P. B. No. 55, Poona.

"Greening* also included the lawn in his experiments. He found that when moss-infested lawns were watered with a solution prepared by dissolving one ounce of permanganate of potash in one gallon of water (this quantity was used per square yard), the moss disappeared. Where the moss growth was particularly prolific, two applications were necessary, the

* Mr. C. B. Greening, B. Sc., Royal Horticultural Society, Wisley, England.

second a fortnight after the first. In every case the solution should be applied immediately after the lawn has been cut, for then the growing tips of the moss plants are exposed. Obviously if there is a heavy growth of grass, the moss may escape saturation.

"A solution of half the above strength used at one gallon per square yard was also effective in ridding lawns of earthworms, whose soil casts are responsible for so much turf fouling. Immediately after the application the earthworms wriggle to the surface, from which they should be swept off before the few servivors have time to return to their burrows."

(For diseases of Lawn Grasses, see page 92, and for manuring lawns, see pages 32 and 172.)

LUCERNE OR ALFALFA

Medicago sativa. Family. *Leguminosæ.*

One of the most valuable leguminous forage crops cultivated in India, it is rightly called the king of fodder plants as it gives a continual harvest without an annual ploughing or seeding. Its cultivation is increasing very rapidly in all parts of the world, including the United States of America, Australia and the southern countries of Europe. It is said that this plant has been cultivated by man for over 2000 years. This in itself shows the great value and usefulness of this hardy, long-lived perennial forage plant. Under Indian conditions, it needs regular irrigation.

Lucerne will grow on nearly all good, well-drained soils, but it thrives best in a deep, friable, loamy soil, with a sub-soil of "murum" or limestone. Even a light, sandy loam which admits of thorough drainage, will grow a good crop. Very deep, black, sticky soil in which drainage is difficult and water is likely to stand for some time, should be avoided. Such black soils as are not very stiff, and have a porous sub-soil at a depth not greater than two to three feet, can be made suitable by a heavy dressing of cattle manure. Calcareous soils are especially suited to it.

Land intended for Lucerne must be thoroughly prepared by deep ploughing and if possible should be allowed to lie fallow for some time and all weeds destroyed. It should be further pulverised and made smooth and fine by carefully breaking up the clods. Farm-yard manure may then be applied at the rate of 30 to 40 cart-loads per acre and thoroughly mixed in the soil by a second ploughing and harrowing.

Lucerne as grown in the Bombay Province is generally planted in square beds laid out for regular irrigation. The size of the beds may be about 10 x 10 feet, and the seed broadcasted. This method yields a good crop at first for some time but, later on weeding being difficult in such beds, the plantation is run over by weeds and becomes unproductive. The other method which is employed more extensively as its advantages become known, is to sow the seeds on ridges two feet apart. For this method the land must be as level as possible and the ridges should run across the slope. so that the irrigation water may not all run to one end of the ridge. This system admits of frequent hoeing and the plantation yields good crops for a longer period.

The seed is sown broadcast by hand either in beds or on the tops of the ridges, and covered lightly with earth by a hand rake. The best time

for sowing is early in the Monsoon or from September to November. About 20-25 lbs. of seeds per acre are required in the bed system and about 15 lbs. in the ridge system. Only the best seeds of good quality which are free from dodder seeds or other impurities, must be sown.

The first few waterings should be at intervals of three days or so, unless there is rain. The water should be carefully given, with some straw or dry grass put in at the entrace of the channel to reduce the water's force, as otherwise the seeds are likely to be washed away. Subsequent waterings may be given every 8 or 10 days in the cold weather and during breaks in the rains, and every 6 or 8 days in the hot weather, according to the nature of the soil.

The plantation must be always kept clear of weeds and a top-dressing of manure should be given twice or thrice a year. About 5 to 10 cart-loads per acre at a time, are enough. Well-rotted farm-yard manure is very suitable. Weeding and top-dressing are both difficult operations in the bed system, but the ridge system is favourable to both of them. By frequently working a country plough or an iron hoe or ridger between the ridges, weeds can be kept down and the soil kept in good condition.

The first cutting can usually be taken after about 8 weeks. Care should be taken that the young plants are not uprooted. An established plantation can yield about one cutting every three weeks or so, giving, on an average, about 2000 pounds per acre for every cutting, or about 80-90 pounds per day. It is always best to allow the lucerne fodder to dry a little before feeding the cattle.

In districts with heavy rainfall like, say, the Konkan, a permanent plantation is not possible as the heavy rains destroy the lucerne crop during the monsoon.

Lucerne is good for the land. Like other legumes, it has the power of gathering nitrogen—one of the essential plant-foods, from the air. Its deep-reaching roots bring up fertilizing elements from the sub-soil and place them where they may be utilized for other crops. Thus it can be used as a green manure and, when ploughed under, its leaves, stubble and roots add much humus and nitrogen to the soil, and leave it in an excellent condition for all other crops.

PAPAYA, PAPAU OR PAPITA

Carica papaya. Family, *Passifloreæ*.

The Papaya is a large, succulent, rapidly growing tree, and is supposed to be native to Tropical South America and the West Indies. It has become thoroughly naturalised in Ceylon and in India where it is successfully grown everywhere on the plains. On the hills, it cannot be grown successfully except in the South, and that too only up to an elevation of about 4000 feet. It is also largely grown and much appreciated in the Hawaiian and Phillippine Islands and also in Brazil. It is also grown on a commercial scale in South Florida and in some parts of California, U. S. A.

It grows to a height of 10 to 20 ft. usually on a single straight stem, with beautiful, large, palm-like leaves symmetrically distributed at the top, giving the tree a beautiful, palm-like appearance. It is so easily grown, produces wholesome fruits in such abundance, is so free from diseases or

insect-pests, and occupies so little space, that it should be grown in every garden, large or small. The papaya is usually propagated from seeds which should be saved from selected fruits grown on healthy trees. It is also propagated from cuttings of side-shoots and by grafting; but these methods are very rarely employed.

It differs from most trees in its flowering habit. Some trees produce only pistillate or female flowers, others develop only male or staminate flowers, while a few have perfect flowers. The male tree does not produce fruits and so should be removed as soon as found. Its first flowers which are sweet smelling and numerous, appear when the tree is only a few months old and are carried on long pendulous stalks. The flower of the female tree is longer than that of the male but has a very short stalk and may be easily recognised by the globular ovary in the centre. As the female tree does not set fruit freely without some male flowers, it is advisable to have at least one male to every hundred female trees. Experiments conducted in the Montgommery district of the Punjab, by the Government Agricultural Department show that a plantation of exclusively female trees produced fruits without seeds. No male trees were allowed to grow for miles around. But it is generally believed that the presence of male trees conduces to the increase of the size and number of fruits.

As the Papaya has a tap root, it is rather difficult to transplant. This, however, can be done successfully if care is used. While transplanting, the seedlings should not be set too deep, otherwise they are likely to rot. A deep, rich soil, either red or black, is suitable. The papaya grows best in a hot, moist climate, but will also grow in a drier climate if properly watered. When grown on a large scale, the land should be twice ploughed and harrowed. Farm-yard or stable manure may be used liberally as it is a gross feeder. About 40 to 50 cart-loads will be sufficient for an acre. If the soil be rich and well manured, it will not be found necessary to give additional manure the first year. But at the end of 10 or 12 months when the trees will come into bearing, some additional manure may be profitably given by digging it in near the roots. The manure given may be either a mixture of animal manure and wood-ashes, using about 15 lbs. to each tree, or the following, which may also be profitably given: Castor cake, nitrate of soda, bone meal and wood-ashes in equal parts, giving about $1\frac{1}{2}$ pounds to each tree. Care should be taken that this fertilizer does not come in direct contact with the roots. After the fertilizer is applied, it may be found necessary for some time, to give water more freely and at shorter intervals.

The usual distance from tree to tree is about 8 ft. which gives about 680 trees to the acre. About 8 ozs. of seeds are needed per acre. Holes may be made about $3' \times 3' \times 2'$, filled up with good soil mixed with manure. This, however, is not quite necessary if the soil is fairly deep, well enriched and well cultivated. Three or four seeds may be sown in each hole. When the seeds come up—which they would do within two to three weeks—remove all but two plants. Or the seedlings may be transplanted from their beds into these holes, two in each. As the proportion of male to female trees is usually 1 to 3 (on rare occasions it may be as high as 1:1), a sufficient number of seedlings must be kept ready to take the place of those which turn out to be males. The trees usually flower after five months and all males (except one or two), must be pulled out. If both the trees in any one hole turn out to be female, as they often do, pull out one, so that there is ultimately only one tree in each hole.

In the Bombay Province, seeds are generally sown twice a year—in February-March and then again in September-October. Careful and sufficient irrigation is necessary, if large yields and heavy fruits are desired. The trees may appear outwardly healthy even though the water supply is really insufficient. When the plants are young, daily watering may be necessary, but later on, if canal or well irrigation is available, it would be sufficient to water them once a week.

Water should never be allowed to stagnate round the roots, as the Papaya is the first fruit tree to suffer from water-logging and rots at the soil-surface. Usually the tree grows a straight stem but sometimes it branches out. It is usually best to remove any side shoots if they appear. Also, remove all dead leaves as soon as they begin to turn yellow. Individual trees vary greatly in their productivity. Some will produce quite a large number of fruits, necessitating thinning out of some of the fruits so as to give them sufficient space to develop, while others may produce only a few fruits. Fruits are generally formed at the axils (the angle formed by a leaf with the stem on the upper side), usually singly but sometimes in twos or threes.

The life of the Papaya tree, under favourable conditions, is about ten years or more. The first two or three years, however, are the most productive and when grown on a commercial scale, the orchard is generally renewed every two or three years. The trees come into bearing within a year's time and keep on producing fruits month after month. The average annual yield for trees in good condition should be in the neighbourhood of twenty to thirty fruits weighing two to four pounds each.

It is well recognised that the Papaya contains peculiar and valuable digestive properties which make it of great value in the diet. A small piece of unripe fruit added to meat while cooking makes it very tender. These properties are largely due to the presence of papain, a very active ferment somewhat similar to pepsin. The papain is secured by scarifying or bleeding the ripening fruits when they are on the trees. The juice is then dried and exported to America and Europe in its crude state. There it undergoes further changes and is sold under various trade names at a high price. Ceylon is the greatest papain producing country on our side.

There are no fixed varieties of the Papaya. The two most common types generally grown being known as long and round–the latter being more or less cocoanut shaped. Of these, the first is supposed to be superior in quality. In Ceylon, the round variety is generally grown, as it grows to perfection there, and is mostly grown on perfectly sexed plants. One variety, with leaf stalks slightly marked purple and known as the Washington, has round fruits of good quality which grow singly in the axils requiring no thinning. Since it is difficult to keep the varieties or types distinct, they seldom come up true from seeds.

The quantity of seeds contained in each fruit seems to depend upon the fertilization or non-fertilization of the flowers at the time of setting fruits. If on account of rains or other climatic conditions, the flowers are not effectively fertilized, the fruits are not likely to contain much seed. Thus, it may be seen that there is no truly *seedless* Papaya. For, if a muslin bag is put around a flower as soon as it is set, no pollination will take place and the resulting fruit would be seedless.

HEDGES

Many dwarf growing shrubs and trees are used for making hedges. Those with small, ever-green leaves and compact growth and which are amenable to pruning make the best hedges.

Hedges are grown sometimes in place of a fence or wall, for which purpose, however, they are not very satisfactory, because unless well-grown in a deep and rich soil and kept clear of weeds and plentifully watered in dry season, a hedge does not present a very pleasing appearance. Ornamental hedges to mark off one portion of the garden from another need more attention and constant pruning to keep them to a desired height and to present a neat and trim appearance.

The ground must be well prepared before sowing the seeds. Make a trench two feet deep and as much wide. If the soil is deep and fertile, only one single row of plants would make a good growth in a short time—say from six months to a year—but if the soil is not so good, it is desirable to put in some good soil and lots of manure and to sow the seeds in a double row, the rows being about two feet apart and the seeds at a distance of about 4 to 6 inches from one another. Cover the seeds about an inch deep and water carefully. At first, in dry weather, water daily or every other day. Later on, when the plants have made some growth—say over a foot—it is desirable that more thorough and copious waterings should be given but at longer intervals.

The best time to start a hedge is usually during the rainy season, but it is also possible to start it after the rains are over, if watering is done frequently and at regular or needed intervals. It is best to sow the seeds directly in the rows where they are needed and not to try to transplant them from other quarters.

It is frequently asked if a hedge would grow without water. If it is started in the rains and if the soil is deep and rich, then the plants will not die in dry season, if not watered. But naturally they would not make the same satisfactory growth and present a green, fresh appearance as when they are regularly watered. But if the ground is very shallow or rocky and the soil poor, a satisfactory hedge cannot be made without watering.

We generally recommend two kinds of seeds for hedges—Inga dulcis and Dodonæa viscosa. The former, known also as Madras Thorn, is a rather coarse, much-branching thorny shrub very largely used for making an impenetrable hedge. When closely and well-grown, it effectively prevents animals from entering. The latter is an ornamental hedge with small, beautiful shining, ever-green leaves very largely used in both Northern and Southern India. If planted in a double row, it makes a perfect hedge within a year's time. It produces pretty, light yellow flowers if not pruned. Though the wood is a little hard, it is amenable to pruning and can be kept to any desired height.

A pound of Inga seeds will sow a row of about 500 feet long and a pound of Dodonæa about twice this length.

GUINEA GRASS

Panicum maximum. Family, *Gramineæ.*

Guinea Grass is a perennial plant, which, if properly grown, yields nourishing green fodder throughout the year. It can be planted along permanent water channels and so provide a daily supply of succulent fodder without extra trouble and expense. It is able to grow well even under shade, such as that of large mango trees. Further, it has the very desirable property of being able to resist drought for long periods of time, so that the plant is able to live and throw out fresh shoots on receiving water again after a lapse of time of so much as six summer months. Where fresh green fodder is a requisite, or where facilities exist, no farm orchard or garden should forego the cultivation of Guinea grass.

Almost any soil, provided it is well drained, will suit the cultivation of Guinea grass. It should not be very shallow but be about 1½ to 2 feet deep, and will be particularly suitable if it is of the medium black variety. Guinea grass responds well to good treatment and a lush growth can be obtained by adequate irrigation and manuring. It is a heavy feeder, and a well prepared or friable soil will help obtain good results. Well-rotted farm yard manure, which may include cow or horse dung, can be used with advantage, and anything upto 30 cartloads per acre can be administered. If pure, city sewage water is being used, manuring should be avoided.

Guinea grass is propagated from root stalks or tussocks and from seed. Propagation from seeds is sometimes more convenient, and is also quite as satisfactory a method. Guinea grass may be cultivated either in flat beds or on ridges, though the former method seems to be generally employed owing to the ease and economy of preparation. The flat beds, however, can later be channelled for irrigation and ridges formed in them if so required, after the plants have taken root.

Guinea grass seeds take about a fortnight or even longer, to germinate, and about 6-8 lbs. of seed should suffice for an acre. Seeds may be sown directly into the ground where plants are required to be grown, and this method may be employed where it is desired to start an extensive cultivation. Guinea grass seedlings however, can stand transplantation, and this latter method is employed generally for ease of operation or if the cultivation is of limited size. After sowing the seeds in well-prepared nursery beds, the seedlings are ready for transplantation into their permanent quarters when they are about 8–10 weeks old or about a foot high.

The transplanted seedlings or the root stalks, as the case may be, should be put into the ground at a distance of about 2-2½ feet from each other, and the soil in between should be kept loose and free of weeds by frequent cultivation. If planted at a distance of 2½ ft. each way, about 7000 sets of root-stalks or tussocks would be required per acre. It is advisable to sow 3–4 seedlings in each hole so as to hasten growth and allow for casualties. Where rains are adequate, irrigation will be found unnecessary during the monsoons, unless there are long dry spells in between. At other times of the year, however, regular irrigation at intervals of 8–12 days will be required.

The first cutting can be made about 4½–5 months after the seeds are sown, that is, about 2½–3 months after they are transplanted. Generally, the grass may be cut when it begins to flower and under favourable conditions 6–8 cuttings should be obtainable annually. After the first cutting, subsequent cuttings can be made once every 50-60 days, though under more favourable conditions, such as during the monsoon or in more suitable localities where growth is heavier and faster, cuttings could be made at considerably shorter intervals of time. The grass should be cut low and as close to the ground as possible. The total annual yield of green fodder per acre varies from place to place, though as a rough guide, 25 tons (or 700 Bengal maunds) may be taken to represent a reasonable figure for average conditions. Under more or less ideal conditions, however, and where intensive methods of cultivation are employed the yield can be as high as 60 tons per acre.

A plantation of Guinea grass should yield good crops for at least 5 years, and when the yield begins to diminish it may be found advisable to renew the plantation with fresh seedlings. When once started from seeds Guinea grass cultivation can later be extended very easily and quickly by separating the tussocks or root stalks and replanting them separately. If really good results are desired, manuring may be repeated after every third cutting. The usual time of the year for planting Guinea grass tussocks or for transplanting seedlings into their permanent quarters is just before the beginning of the rains.

Guinea grass has been found to be a very valuable fodder for animals, especially milch cattle, and can be used either as green fodder or as hay. When planted along water channels, apart from yielding a continuous supply of fodder, it keeps the sides clean and free of weeds and other grasses. Guinea grass is very hardy and appears to be remarkably free from subjection to any disease or insect pest.

This is a reference book which must always be kept ready at hand. It contains a wealth of practical and useful information seldom found in other similar works.

Do not omit to go through the Index, given at the end of the book, if only to know what subjects are treated.

PART VI

TEN USEFUL FORMULÆ

CONTENTS OF PART VI

Lead arsenate	...	...	170
Paris green	...	...	170
Nicotine	...	...	170
Bordeaux Mixture	...	...	170
Lime-sulphur	...	...	171
Poison Baits for Cutworms and Grasshoppers			171
Mice Poison	...	...	171
Kerosene Spray	...	...	172
Fertilizer for Potted Plants		...	172
Lawn Fertilizer	...	...	172

TEN USEFUL FORMULÆ

I. Lead arsenate

(*i*) Lead arsenate spray :

Lead arsenate	...	1 lb.
Water ...	...	50 gallons.

(*ii*) Lead arsenate dust :

Lead arsenate	1 lb. (or one part.)
Hydrated lime	8 lbs. (or 8 parts.)

II. Paris green

(*i*) Paris green spray :

Paris green	...	8 ozs.
Water ...	...	50 gallons.

(*ii*) Paris green dust :

Paris green	1 lb. (or one part.)
Hydrated lime	20 lbs. (or 20 parts.)

III. Nicotine

(*i*) Nicotine spray:

Nicotine sulphate ...		2 oz.
Soft soap ...	...	8 oz.
Water ...	...	12½ gallons.

[Soft soap is generally made from olive oil or cotton-seed oil, four parts and caustic potash, one part.]

(*ii*) Nicotine dust:

Nicotine sulphate	...	1 oz.
Hydrated lime	...	1 lb.

(Keep the dust in air-tight containers.)

IV. Bordeaux Mixture

(*i*) 4-4-50 strength:

Copper sulphate	...	4 lbs.
Quicklime ...	...	4 lbs.
Water ...	...	50 gallons.

(*ii*) 5-5-50 strength:

Copper sulphate	...	5 lbs.
Quicklime ...	...	5 lbs.
Water ...	...	50 gallons.

Take half the quantity of water and dissolve copper sulphate in it, in a wooden tub or earthen pot. This can be easily and efficiently done by putting copper sulphate crystals in a gunny bag and suspending them in water, over night.

CAUTION — Lead arsenate, Paris green, copper sulphate etc., are poisonous and great care should be taken while handling and using them.

Slake the lime by adding a little water gradually till the whole quantity is slaked. Then pour water which has remained, in the solution.

Pour both the liquids into a third vessel mixing them thoroughly, by stirring. Strain the mixture while pouring it into the sprayer, before spraying operation.

V. Lime-Sulphur

Quicklime	... 8 lbs.
Sulphur (powdered)	... 8 lbs.
Water	... 50 gallons.

Place the lime in a tub and pour enough water to cover it. No sooner slaking begins add sulphur and keep stirring to prevent caking at the bottom of the tub. When all the lime is slaked in this paste cool it by adding some more water. Make upto 50 gallons by adding remaining water. Strain the liquid before using. (For making a stronger solution, see p. 129.)

VI. Poison baits for cutworms and grasshoppers.

(*i*)	Bran	... 20 lbs.
	Arsenate of lead powder ...	... 1 lb.
	Molasses	... 2 quarts.
	Oranges or lemon	... 3 fruits.
	Water	... 4 gallons.
(*ii*)	Dry bran	... 25 lbs.
	White arsenic or Paris green	... 1 lb.
	Syrup or molasses	... 2 quarts.
	Water	... 2.4 gallons.

Mix the dry materials thoroughly in a wooden tub or any other suitable container. Mix fruit juice and molasses with water, and prepare a mash by pouring and mixing it, into the tub containing dry materials. Let the mash stand a few hours, then spread it in the afternoon all over the affected area, in small lumps.

CAUTION—White Arsenic is a deadly poison and has to be used and handled very cautiously. The operator, servants, etc., must wash their hands thoroughly clean after they have worked with it. Even small traces of it may prove fatal.

VII. Mice poison

(*i*)	Starch	... 1 tablespoon
	Cold water... ...	... ½ cupful
	Boiling water ...	... 1 pint.
	Powdered strychnine	... 1 oz.
	Powdered baking soda	... 1 oz.
	Table salt	... 1 teacupful.
	Oats or maize grains	... 12 quarts.

Mix the starch with cold water and pour the paste into boiling water, stirring it, while mixing. In another container mix baking soda and strychnine and make it into a paste. Add salt. After mixing it thoroughly apply it to oats or maize grains.

CAUTION—Strychnine is highly poisonous and great care should be taken while handling and using it.

Mice Poison—(Continued)

These poisoned grains may be placed into cans and they may be left where mice are likely to damage crops.

Small piles of these grains placed in the fields will also be useful in eradicating **rabbit** trouble.

(*ii*)	Zinc phosphide	1 oz.
	Flour and sugar	19 ozs.
(*iii*)	Arsenic	1 oz.
	Flour and sugar	6 ozs.

VIII. Kerosene spray

Kerosene	2 gallons.
Laundry soap	8 ozs.
Boiling water	1 gallon.

Dissolve soap in boiling water. After removing it from fire add kerosene to the vessel with soap solution. While adding kerosene keep on stirring until mixture is creamy. Cool and store this stock solution. Before using dilute one part of the stock solution with 15-20 parts of water. This spray would control all kinds of soft-bodied sucking insects. (*See also page 129.*)

IX. Fertilizer for potted plants

Sodium phosphate ...	1 oz.
Sodium nitrate ...	1 oz.
Sulphate of ammonia ...	1 tablespoon
Sugar	2 teaspoons.

Mix the above ingredients thoroughly. While watering plants dissolve ½ teaspoonful of mixture in 1 quart of water. This solution should be given once a week per pot.

X Lawn Fertilizer

Sulphate of ammonia ...	12 parts
Superphosphate ...	3 parts
Sulphate of potash ...	1 part
Sulphate of iron ...	4 parts.

Mix the above ingredients thoroughly and apply to lawn at the rate of 1 oz. to 1 sq. yard once a month. The mixture should be applied when the ground is damp and the grass dry.

PART VII

USEFUL INFORMATION

CONTENTS OF PART VII

	Page
To Figure the Number of plants required to the Acre	174
Table for Surface Measure	174
How to Measure off Small Lots of Land ...	175
Fertilizing Table	175
Measuring Water (An inch of rain) ...	175
Water	175
Table of Relative Measures and Weights of Water	176
How to Measure the Heights of Trees ...	176
How to Destroy Unwanted Trees	177
Measuring Area of Irregular Land ...	177
Computation of Acreage (Gunter's Chain) ...	178
How to Dilute Disinfectant Fluids	178
Absolute Zero of Temperature	179
Composition of Air	179
Diffusion of Gases	179
Measures of Heat	179
Standard Multipliers	179
Calculating Cubic Contents of a Tree (Measuring round timber.)	180
The Metric System	180
Capacity Memoranda	180

To Figure the Number of plants required to the Acre

To find the number of plants required to plant an acre, multiply the distance apart that the plants are to be set in the rows, by the distance between the rows, then divide 43,560 (the number of square feet to the acre) by the result.

Example—Suppose the plants are to be set 2 feet apart in the rows, and the rows are 2 feet apart. 2×2=4 feet, 43,560÷4=10890, the number of plants required to the acre.

If the plants are to be set one inch apart, it would be necessary to multiply 43,560 square feet by 144, the number of square inches in a foot, giving 6,272,640 plants required to the acre if set out one inch apart. If set 2 inches by 2 inches apart, multiply 2×2=4 inches, and divide 6,272,640 by the result 4, which equals 1,568,160.

Distance apart	Number per acre.	Distance apart	Number per acre	Distance apart	Number per acre
1 foot ...	43,560	8½ feet ...	603	16 feet ...	170
1½ feet ...	19,360	9 " ...	537	16½ " ...	160
2 " ...	10,890	9½ " ...	482	17 " ...	150
2½ " ...	6,970	10 " ...	435	17½ " ...	142
3 " ...	4,840	10½ " ...	393	18 " ...	134
3½ " ...	3,556	11 " ...	360	18½ " ...	127
4 " ...	2,722	11½ " ...	329	19 " ...	120
4½ " ...	2,151	12 " ...	302	19½ " ...	114
5 " ...	1,742	12½ " ...	278	20 " ...	108
5½ " ...	1,440	13 " ...	257	22 " ...	90
6 " ...	1,210	13½ " ...	239	24 " ...	75
6½ " ...	1,031	14 " ...	222	26 " ...	64
7 " ...	889	14½ " ...	207	28 " ...	55
7½ " ...	774	15 " ...	193	30 " ...	48
8 " ...	680	15½ " ...	181	35 " ...	38
				40 " ...	27

Table for Surface Measure

144	Sq. Inches	... ...	1 Sq. Foot
9	Sq. Feet	... ...	1 Sq. Yard
30¼	Sq. Yards	... ...	1 Sq. Rod or Perch
40	Sq. Perches	... ...	1 Rood
4	Roods	... ...	1 Acre
4840	Sq. Yards	... ...	1 Acre
43560	Sq. Feet	... ...	1 Acre
640	Acres	... ...	1 Sq. Mile

33 ft. × 33 ft. (1089 sq. ft.) ... 1 Guntha
40 Gunthas (43560 Sq. ft.) ... 1 Acre

How to Measure off Small Lots of Land

10 rods × 16 rods	1 acre	60 feet × 726 feet	1 acre
8 " × 20 "	1 "	120 " × 363 "	1 "
5 " × 32 "	1 "	20 " × 2178 "	1 "
4 " × 40 "	1 "	30 " × 1452 "	1 "
5 yds. × 968 yds.	1 "	25 " × 1742 "	1 "
10 " × 484 "	1 "	200 " × 108·9 "	½ "
20 " × 242 "	1 "	147½ " × 147½ "	
40 " × 121 "	1 "	100 " × 145·2 "	⅓ "
$208\frac{7}{10}$ feet × $208\frac{7}{10}$ feet	1 "	120½ " × 120½ "	
		100 " × 108·9 "	¼ "
220 feet × 198 feet	1 "	104⅜ " × 104⅜ "	
110 " × 396 "	1 "	73¾ " × 73¾ "	⅛ "

FERTILIZING TABLE

Dealers in cataloguing Fertilizers generally advise the application of a given quantity per acre. As this often puzzles persons who have only a small garden to cultivate, the following table will prove useful:

Quantity per acre	Equivalent per 10 sq. ft.	Quantity per acre	Equivalent per 10 sq. ft.	Quantity per acre	Equivalent per 10 sq. ft.
100 lbs.	1/3 oz.	800 lbs.	3 oz.	1,500 lbs.	5½ oz.
200 lbs.	¾ oz.	900 lbs.	3⅓ oz.	1,600 lbs.	5 9/10 oz.
300 lbs.	1 1/10 oz.	1,000 lbs.	3⅔ oz.	1,700 lbs.	6¼ oz.
400 lbs.	1½ oz.	1,100 lbs.	4 oz.	1,800 lbs.	6 3/5 oz.
500 lbs.	1 4/5 oz.	1,200 lbs.	4 2/5 oz.	1,900 lbs.	7 oz.
600 lbs.	2 1/5 oz.	1,300 lbs.	4¾ oz.	Ton	7 1/3 oz.
700 lbs.	2½ oz.	1,400 lbs.	5 1/7 oz.		

MEASURING WATER
(An inch of rain)

Water is measured by the acre-inch, which means sufficient water to cover one acre, one inch deep. For instance, six acre inches is water sufficient to cover six acres one inch deep, two acres three inches deep or one acre six inches deep.

One acre contains 43,560 square feet or 6,272,640 square inches. An inch deep of rain on an acre yields 6,272,640 cubic inches of water, which, at 277·274 cubic inches to the gallon, makes 22,622·5 gallons; and as a gallon of distilled water weighs 10 lbs., the rainfall on an acre is 226,225 lbs. avoirdupois. At 2,000 lbs. to the ton, an inch deep of rain weighs 113·115 tons per acre, or for every 100th of an inch (1 cent.) considerably over a ton of water falls per acre.

Water

By volume	Hydrogen 2, Oxygen 1	H_2O	By weight	Hydrogen 1, Oxygen 8

WATER—(Contd.)

Maximum density at 4 deg. Cent.

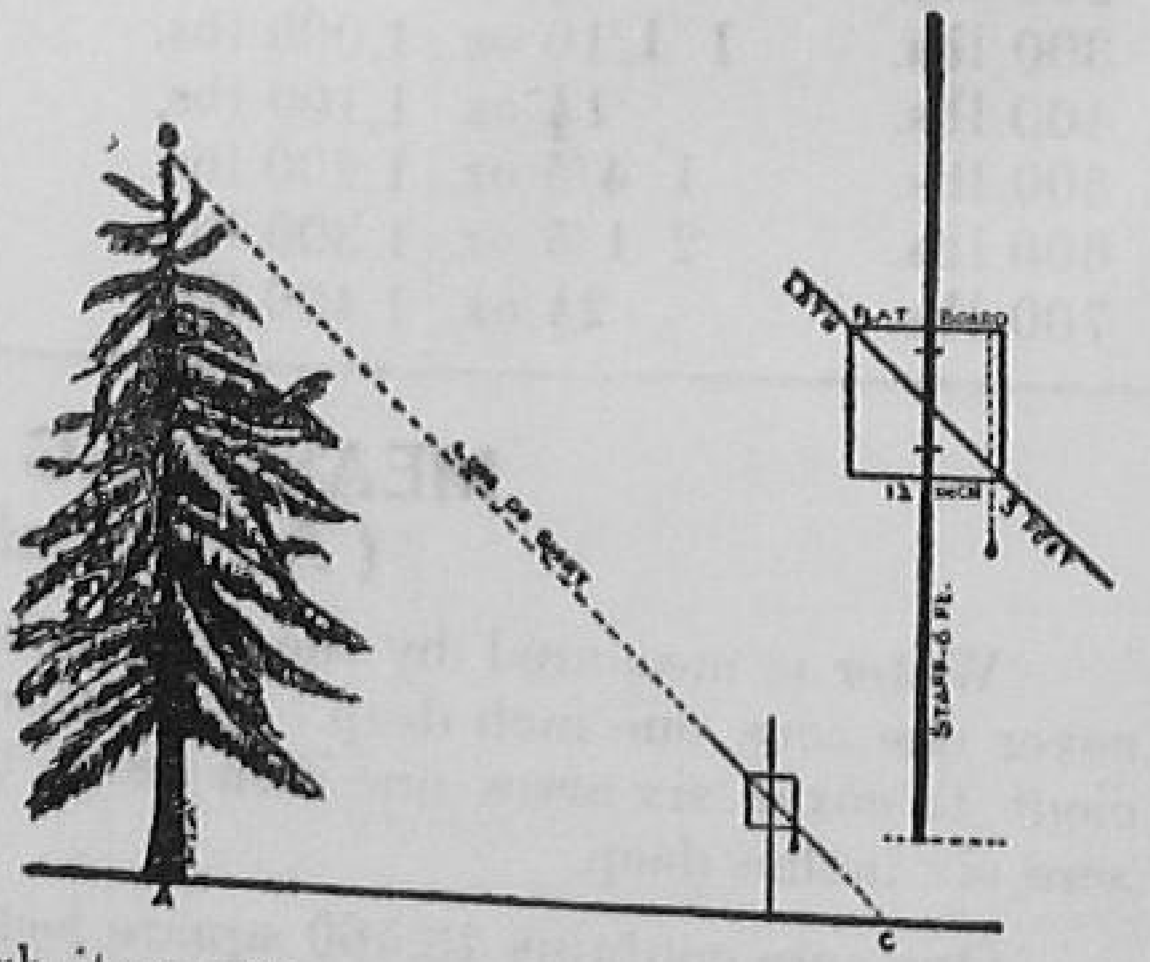
Between 4 deg. Cent. and 0 deg. Cent., water expands by cold.

Table of Relative Measures and Weights of Water

	Cubic inches.	Lbs. weight.	Kilo-grammes.	Litres.	Gallons.
One lb. weight ...	27.73	1	0.454	0.454	0.1
One gallon ...	277.3	10.	4.54	4.54	1.
One Cubic Foot ...	1728.	62.3	28.31	28.31	6.23
One Cubic Yard...	...	1682.7	764.5	764.5	168.27
One Ton (weight)	...	2240.	1016.	1016.	224.
One Barrel ...	...	360.	163.3	163.3	36.
One Hogshead ...	...	540.	244.9	244.9	54.

How to Measure the Heights of Trees

I Measuring trees, etc.—This very simple plan of ascertaining the height of trees, etc., is taken from an old number of the Journal of Horticulture, London. The tree measurer on the right of the figure consists of a staff six feet long, pointed for pressing into the ground. To the centre of the staff a board half inch thick, twelve inches wide, and exactly square is affixed with screws. The diagonal cross lath is three feet long and perfectly straight. It may be fixed or movable; if the latter, a small button being screwed on the board for it to rest on when in use. The plumb line is indispensable, as no correct measurement can be had without it. The plumb-bob may be about the size of a small walnut, the string passing through its centre.



In measuring the tree, the staff is placed at a distance from it, so that with the plumb exactly perpendicular, the cross lath points to the top of the tree. The person taking the "sight" resting on one knee or reclining to bring the eye to the bottom of the lath. The lath is then drawn to the ground, where the end rests at "C" in the figure, or, if the lath is fixed, a string will answer the purpose of extending the sight line to the ground. From this point "C" to the centre of the trunk will represent the actual height of the tree; or to put the matter concisely, the horizontal line A C is equal to the vertical A B.

When the ground is irregular, provision must be made for having the line level from the root of the tree, or A in the figure to C.

The central board must be a true square, the perfectly straight sighting lath resting across it exactly from corner to corner, as the least deviation will lead to error, and the weight must hang positively plumb, otherwise the measurement will not be accurate.

II Rule:—Measure a pole, and hold it exactly perpendicular in the sun, and measure its shadow, then measure the shadow of the tree whose height is desired. Then multiply the length of the pole by the length of the tree's shadow, and divide the product by the length of the shadow of the pole, and the result will be the height of the tree. This method is useful only if the shadows fall on an even surface of ground.

Example:—If a pole 3 feet long casts a shadow $4\frac{1}{2}$ feet long, what is the height of a tree whose shadow measures 180 feet?

Solution:—$180 \times 3 \div 4\frac{1}{2} = 120$ feet, the height of the tree.

HOW TO DESTROY UNWANTED TREES
(A note on Tree Poison)

Preparation:— Take—

White arsenic	1 part
Sodium carbonate (which is the same as washing soda)	4 parts
Water	10 parts

Boil slowly in an iron vessel till dissolved. As some of the water may evaporate in the process of boiling, add enough water to make up the original volume.

Caution The poison is a deadly one and has to be used and handled very cautiously. It should never be used as a weed-killer. The operator, servants, etc., must wash their hands thoroughly clean after they have worked with it. Even small traces of it may prove fatal. While boiling, avoid the fumes as they are injurious to the eyes and the nose.

Use It has to be used in injecting big trees. If the diameter of the tree is from 4-6", a bore half an inch in diameter is to be drilled in a slanting manner to a depth of 6 inches at least. Then about one half ounce, or three tea-spoonfuls of the liquid is put into the hole and the mouth closed either by a peg of wood or by a plug of mud. The tree should be allowed to die its own death. If the diameter of the stem is bigger, then 2 or 3 holes should be bored at different levels on the tree in different places and these should be treated as above.

MEASURING AREA OF IRREGULAR LAND

Where a field or piece of land is not a regular area, such as a square or a rectangle, the simplest method of calculating its area in square feet or yards, is to draw a sketch showing the measurements of each side (taking care to draw accurate angles), and then divide the sketch into

convenient triangles. Calculate the area of each triangle and add; the total thus arrived at will be the area of the irregular land.

The area of a triangle can be found by multiplying the base by one-half the altitude, altitude meaning the perpendicular line drawn from the vertex of the triangle to the corresponding base.

COMPUTATION OF ACREAGE (Gunter's Chain.)

In the computation of acreage the easiest method will be links.

7·92 inches = 1 link. 100 links, or 66 ft., or 4 poles = 1 chain.
10 chains long by 1 broad, or 10 square chains = 1 acre, or
100,000 square links = 1 acre 80 chains = 1 mile.

To reduce square links to acres, point off five figures to the right, that is, divide by 100,000, the result is acres and a fraction in decimals. Multiply the decimals by 4 and point off five places again, which gives rood and a fraction in decimals. Multiply the decimal by 40 and mark off 5 figures, then we get poles –

e.g., 1234567 square links
= 12·34567 acres = ·34567 × 4
= 1·38268 roods = ·38268 × 40
= 15.30720 poles. Answer – 12 acres, 1 rood, 15·30720 poles.

How to Dilute Disinfectant Fluids (Approximately).

1-100

1 tablespoonful to 2½ pints	1 gill to 3 gallons
1 fluid oz. to 5 pints	½ pint to 6¼ gallons
1 wineglassful to 5 quarts	1 quart to 25 gallons

1-200

1 teaspoonful to 1¼ pints	1 wineglassful to 10 quarts
1 tablespoonful to 5 pints	1 gill to 6 gallons
1 fluid oz. to 10 pints	

1-400

1 teaspoonful to 2½ pints	1 gill to 12 gallons
1 tablespoonful to 10 pints	½ pint to 25 gallons
1 fluid oz. to 20 pints	1 quart to 100 gallons
1 wineglassful to 20 quarts	

1-600

1 teaspoonful to 2 quarts	1 fluid oz. to 4 gallons
1 tablespoonful to 2 gallons	

Note:—The contents of a tablespoonful approximates half a fluid oz., and that of a wineglassful 2 fluid ozs. 2 tablespoonful 1/20 of a pint or 1/160 of a gallon.

Absolute Zero of Temperature: −460 deg. Fahr., or −273 deg. Cent.

Composition of Air: Nitrogen, 77.95. Oxygen, 20.62. Watery vapour, 1.40. Carbonic Acid Gas, 0.04.

Diffusion of Gases: Gases diffuse inversely as the square root of their respective densities (Graham's Law.)

Measures of Heat

Three scales are in common use, Fahrenheit (F.), Centigrade (C.), and Réaumur (R.). The freezing and boiling points of water on each of these scales are:

		Freezing.	Boiling.
Fahrenheit	...	32°	212°
Centigrade	...	0°	100°
Réaumur	...	0°	80°

To convert F. to C. subtract 32, multiply by 5 and divide by 9.
To convert C. to F. multiply by 9, divide by 5 and add 32.
To convert F. to R. subtract 32, multiply by 4 and divide by 9.

Standard Multipliers

Circle, area	=	square of radius × 3.14159
,, circumference	=	diameter × 3.14159, or 3 1/7 nearly
,, ,,	=	radius × 6.283185
,, diam'tr	=	circumference × 0.31831
,, ,,	=	square root of area × 1.12838
,, radius	=	circumference × 0.159155
,, ,,	=	square root of area × 0.56419
,, side of sq. of eq. area	=	diameter × 0.886
,, side of inscribed square	=	diameter × 0.707
Cone or Pyramid, solidity	=	area of base × one-third of altitude
Ellipse, area	=	product of diameters × 0.7854
The area of the surface of a sphere	=	square of the diameter × 3.1416
The volume of a sphere	=	cube of the diameter × .5236

How to calculate the cubic contents of a tree (Measuring round timber.)

The conventional method of finding the cubic contents of round timber is as follows:—

Multiply one-fourth of the average girth square by the length;

$$\text{or } \frac{G^2 \times L}{4}$$

Note:—If the girth is taken in inches and the length in feet, divide the result by 144 to obtain the contents in cubic feet.

The Metric System

1 Metre (m) = 10 decimetres = 39.37 inches.
= 100 Centimetres (cm.)
= 1000 Millimetres (mm.)
10 Metres = 1 dekametre = 10.93611 yds.
100 ,, = 1 hectometre = 109.3611 yds.
1000 ,, = 1 kilometre = 1093.611 yds.
10 Millimetres (mm) = 1 Centimetre (cm) = 0.3937 inch.
10 Centimetres = 1 decimetre = 3.9371 inches.
5 cm (Centimetres) = About 2 inches.
Kilometre is 0.621 of a mile, or 1093.6 yards or about 5/8 of a mile.
Litre is 61 cub. ins, or 1.76 imperial pints, or 0.22 of a gallon.
Gramme is 15.432 grains Troy.
Kilogramme is approximately 2.205 pounds avoir. (2 lbs. 3 ozs.)
I yard = .914401 metres.
1 mile = 1.609347 kilometres.

To convert		Multiply by
Cubic centimetres into fluid ounces	...	0.0352
Litres into fluid ounces	...	35.2
Fluid ounces into cubic centimetres	...	28.42
Pints into litres	...	0.568
Grammes into grains	...	15.432
Grammes into ounces avoir	...	0.03587
Grammes into ounces troy	...	0.3215
Kilogrammes into pounds	...	2.2046
Grains into grammes	...	0.0648
Ounces avoirdupois into grammes	...	28.35
Ounces troy into grammes	...	31.104
Metres into inches	...	39.37
Inches into metres	...	0.0254

Capacity Memoranda

One Imperial gallon

= 277.24 cubic inches
= 0.16 cubic foot
= 10 lb. fresh water = 70,000 grains
= 10.272 lb. of salt water
= 4.54 litres
= 4.54 kilogrammes
= 0.454 cubic metre

One cubic foot of water

= 6.23 imperial gallons = 62.35 lb.
= 28.375 litres = 0.557 cwt.
= 0.0283 cubic metre = 0.028 ton

---

5 ounces avordupois of water make 1 Gill

4 Gills	make	1	Pint
2 Pints	,,	1	Quart
4 Quarts	,,	1	Gallon

INDEX

	Pages
Activated Compost	33
Alfalfa (Lucerne)	162
Amaranthus, Diseases of ...	86
Antirrhinum	43, 86
Ants (Ordinary) ...	15-17
,, White ...	16, 17, - 83, 84, 85
Artichoke, Globe or French	104
Asparagus	138
Aster	43, 86
Aubergine (Brinjal)	146
Balsam	46
Beans, Broad	131
,, Cuba or Asparagus ...	134
,, Dwarf	132
,, French or Kidney ...	132
,, Lima, Double or Butter ...	133
,, Runner or Pole ...	132
,, Scarlet Runner ...	133
,, Velvet	134
Beans, Sowing of	13
,, Control of Weevil ...	137
Beet Root	102
Begonias	47, 88
Beetles (Cockchafer)... ...	97
Bhendee (Lady's Fingers) ...	141
Bitter Gourd	119
Borecole	109
Borecole, Diseases of ...	114
Bottle Gourd	119
Boxes...	7
Brinjal	146
Broccoli	109
Broccoli, Diseases of ...	114
Brussels Sprouts	110
Brussels Sprouts, Diseases of	114
Cabbage (European)... ...	110

	Pages
Cabbage, Diseases of ...	114
Cabbage, Chinese	111
,, Savoy	111
Canary Creeper	71
Canna	49
Capacity Memoranda ...	180
Capsicum	144
Cardoon	105
Carnation	53, 88
Carrot	152
Caterpillars	83
Cauliflower	112
Cauliflower, Diseases of ...	114
Celeriac	154
Celery	153
Chichinda (Snake Gourd) ...	120
Chicory	106
Chilli	144
Chinese Cabbage	111
Chrysanthemum ...	54, 89
Climbers and Creepers ...	78
Cockchafer Beetles	97
Compost, Activated	33
Computation of Acreage ...	178
Composition of Air	179
Corn (Maize)... ...	13, 130
Corn Salad	156
Cosmos	57, 89
Cress	113
Cress, Water	113
Cuba Beans	134
Cucumber	118
Cucumber, Diseases of ...	126
Dahlia	57
Dahlia, Diseases of	89
Damping off	9, 10
Delphinium	67
Dilpasand (Denshi)	119
Diseases, various	86

INDEX (Continued.)

PAGES

Diseases of Cruciferæ (Cabbage) family 114
Doodhee (Bottle Gourd) ... 119
Dodonæa (Under Hedges) ... 166
Drainage 8
Edging (Plants for) 78
Egg Plant 146
Endive 106
Fertilizers 22,29
Fertilizing Table 175
Flowers, How to keep fresh 78
„ Fragrant 78
Flowers for Shady Places ... 77
Fluids, Disinfectant, How to Dilute 178
Foliage, (Ornamental) Plants 78
Fungicides 82
Fungoid Diseases 82
Gases, Diffusion of 179
Geranium, Diseases of ... 90
Germination time ... 14-15
Ghee Turai 121
Gladiolus 67, 90
Globe Artichoke 104
Gloxinia 69
Gourds, Bitter 119
„ Bottle 119
„ Ghee Turai or Luffa 121
„ Snake 120
„ Sponge 121
„ White or Wax ... 121
„ Diseases of ... 126, 127
„ Insect Pests of 127,128, 129
Guinea Grass... 167
Green Manuring ... 20, 26
Gumbo (Okra) 141
Heat, Measures of 179
Hedges 166
Hints on raising flowers 38-42
Hollyhock, Diseases of ... 91

PAGES

Humus 19
„ Permanganate of Potash as a Humus Former 36
Indian Corn (Maize)... 13, 130
Inga dulcis (Under Hedges) 166
Insect Pests and Diseases 80
Insecticides, (Useful formulæ) 170-172
Iris, Diseases of 92
Irregular Land, Measuring Area of 177
Jhinga (Sponge Gourd) ... 121
Kale 109
Kale, Diseases of ... 114
Karela (Bitter Gourd) ... 119
Kerosene Emulsion ... 129, 172
Kidney Beans 132
Khamach (Velvet Beans) ... 134
Knol Khol (Kohl Rabi) ... 114
Lady's Finger 141
Lamb's Lettuce (Corn Salad) 156
Land, How to Measure 175,177,178
Larkspur, Diseases of ... 92
Lauki (Bottle Gourd) ... 119
Lawns 159
Lawns, Fertilizer for 32, 172
Lawns and Permanganate of Potash 161
„ disease of 92
Leek 140
Lettuce 107
Lime 20
Lime-Sulphur ... 129,171
Liquid Manure 27
Loam, Definition of 19
Lobiya (Cuba beans) ... 134
Lucerne 162
Luffa 121

INDEX (Continued.)

PAGES

Madras Thorn (Under Hedges) 166
Maize (Corn) 13,130
Mangel Wurzel (Mangolds)
See under Beetroot 102
Manures 19
,, Chemical 29
,, Cow... 19
,, Green ... 20,26
,, Liquid 27
,, and Soil 28
Manurial Programme ... 30
Marrow (Vegetable) 126
Melon, Musk 122
,, Diseases of ... 126, 127
,, Water 124
,, ,, Diseases of 126,127
Melons, Insect Pests of 126,127
Metric System 180
Microbes 86
Mice Poison 171
Mildew 93
Multipliers, Standard ... 179
Mustard 115
Nasturtium 69
New Zealand Spinach ... 143
Okra 141
Onion 140
Oyster Plant 108
Padwal (Snake Gourd) ... 120
Palak (Spinach) ... 103,143
Palms, Manure for 32
Pansy... ... ... 71, 92
Papaya, Papau, Papita ... 163
Parsley 155
Parsnip 155
Peas (Culinary) ... 13,134
Pepper (Capsicum) 144

PAGES

Permanganate of
Potash 13, 36, 152
Petunia 72
Phlox 73, 92
Plants, Rock 77
Plants, Number per acre ... 174
,, Edging 78
,, For Foliage effect ... 78
Poi Sag (Climbing Spinach) 103
Poison Baits 171
Poisons, Contact 81
,, Stomach 81
,, for Trees 177
Pop Corn 131
Pots 7
Powdery Mildew 96
Pumpkin 124
Pumpkin, Diseases of 126, 127
Radish 116
Rat (Mice) Poison 171
Rayee (Mustard) 115
Rhubarb 143
Rock Plants 77
Roselle 142
Roses, Manure for 31
Roses, Diseases of ... 93, 96
Runner Beans ... 132,133
Rutabaga 118
Sag—Poi or Poi Koi ... 103
Sags, various 102
Salsify 108
Savoy Cabbage 111
Scarlet Runner 133
Scorzonera 108
Sea Kale (See under Beet) ... 103
Seeds, Capriciousness of ... 14
,, Care of "Difficult" ... 14
,, Depth of Sowing ... 8

INDEX (Continued.)

	Pages
Seeds, Enemies of	15
„ How Stored	7
„ How to Sow	8
„ Slow-germinating ...	14
„ Sowing in Beds ...	13
„ Tiny	9
Seed, What is a ...	5,156
Sem (various beans)	131-134
Slugs	83
Snails	83
Snake Gourd	120
Snapdragon (Antirrhinum)	43,86
Soils, Composition of ...	7
„ Treatment under Damping off	9, 10
„ and Manure	28
Sorrel, Red or Indian ...	142
Spinach	103
„ Climbing (Poi Sag)	103
„ New Zealand ...	143
„ Various Indian ...	102
Sponge Gourd	121
Squash	126
Success, Essentials of ...	7
Sunflower, Diseases of ...	94
Sweet Peas	74, 94
Sweet William, Diseases of	94
Swiss Chard	103
Swede (under Turnip) ...	118
Tables (Useful) ...	174-176
Temperature, Absolute Zero of	179
Tensi (Dilpasand)	119
Termites (White Ants)	16,17, 83-85
Tinda (Dilpasand)	119
Tins	7
Tobacco Dust	145
„ Infusion	128
Tomato	147, 150

	Pages
Tomato Culture, Recent Advances in	150
„ and Damping off ...	151
„ & Permanganate of Potash	152
Tori (Sponge Gourd) ...	121
Transplanting	12
Trees, How to destroy unwanted	177
„ How to measure height	176
„ Number per acre ...	174
„ Cubic contents (Measuring round timber.)	180
Tropæolum (Nasturtiums) ...	69
Turai (Tori)	121
Turnip	117
Turnip, Diseases of ...	114
Turnip-rooted Celery ...	154
Useful Information ...	174-180
Vegetables, Cool and Warm Season	100
„ English, under S. W. Monsoon	101
Vegetable Marrow	126
Vegetable Oyster	108
Velvet Beans...	134
Violet, Diseases of	94
Verbena, Diseases of ...	94
Water, How to	8
„ When to	9
„ How to Measure ...	175
„ Table of Relative Measures & Weights	176
Water Cress	113
Water Melon	124
Wax Gourd	121
Weevils	137
White Ants ...	16,17, 83,84,85
White Gourd...	121
Zero Temperature	179
Zinnia	76, 95